SCIENCE

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CONTENTS.

River Courses in the Jura Mountains. Emm. De Margerie 1
Indiana Academy of Science 2
The Cruise of the Clover—Further Remarks on the Aberrations of Audibility of Fog Signals—The Methods Used. Arnold Burges Johnson 3
Sassafras Trees. Walter J. Quick 6
The McMillan Chemical Laboratory. De'os Fall 7
The Gradual Disappearance of the Range Grasses of the West. I. W. Tourney 9
Meeting of the Iowa Academy of Sciences 10
Baltimore Meeting of the American Chemical Society. Charles Platt 11
Letters to the Editor:
Do Earth Worms Rain Down? Charles B. Palmer 11
Late-Blooming Trees. F. J. Thompson 11
A Correction. W. M. Beauchamp 12
Late-Blooming Trees. Thomas S. Stevens 12
As to Feigned Death in Snakes. H. H. Everett 12
The Least Bittern. Fred Mather 12
Book-Reviews 13

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First inserted June 19, 1891. No response to date.

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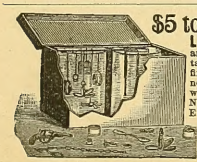

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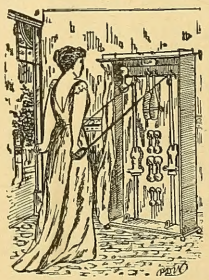

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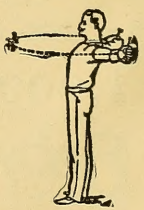

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SCIENCE

NEW YORK, JANUARY 5, 1894.

RIVER COURSES IN THE JURA MOUNTAINS.

BY EMM. DE MARGERIE, PARIS, FRANCE.

It is well known to readers of *Science* that Prof. W. M. Davis, in his admirable analysis of the origin of the Valleys of Pennsylvania (National Geogr. Mag., Vol. I., No. 3, 1889), started from the assumption of a purely consequent, original course for the rivers which have excavated most of the Appalachian Valleys. As an illustration of such a kind of drainage system existing at the present time the Jura Mountains were given, following a statement published by Col. de la Noë and myself in our joint work, "Les Formes du Terrain" (Paris, 1888).

More recently, however, Prof. Davis has been led to change this view, according to the results reached by Mr. Aug. F. Foerste, in his valuable account of "The Drainage of the Bernese Jura" (Proc. Boston Soc. Nat. Hist., Vol. XXV., p. 392–420, 1892).

While admitting that Mr. Foerste has clearly shown that the River Birse could not have taken its present path if it had been a purely original consequent stream, I cannot agree with him when he endeavors to show that recourse must, *of necessity*, be had to the postulate of an antecedent origin; for it seems highly improbable that such a small river, whose upper drainage area is of so little extent, could have victoriously reinted the uplift of such great anticlinals as the Graitery, the Raimeux, the Roche and the Choindez folds are. The failure of other explanations to meet the facts, which is given by Mr. Foerste, together with the systematic arrangement of several series of *cluses* in straight lines, as the main support of the theory of an antecedent origin (loc. cit., p. 411), does not seem to constitute a valid argument: are we absolutely certain not to have overlooked some possibility, which could turn out, when followed out in detail, to involve the true explanation?

But, apart from these considerations, if such is really the origin of the *Cirques* followed by the Birse, we should expect to find in the Jura Mountains many other examples of the same absence of relation between river-courses and constructional form. In order to test in a definite manner the validity of Mr. Foerste's conclusions, and to see whether his theory may be of general application in the Jura or not, my friend, Col. de la Noë, has lately drawn, at my request, a large map of the whole country between Bâle, on the Rhine, and Belley, near the Rhone, a map upon which all the heights have been referred to a common datum plane (in a stratigraphical sense), viz.: the limit between the uppermost Jurassic beds and the base of the Cretaceous (Neocomien); as a basis for the work, use was made of the sheets of the new map of France, drawn in contours with 20 metres vertical interval on the scale of 1:200,000, geological boundaries being adjusted on the same from the detailed maps of the French and Swiss Surveys. The altitude reached at any point by the horizon selected, above the present surface, if denuded, or underground, if covered by more recent deposits, could be computed with a fair degree of approximation, thanks to the numerous measurements of sections published during the last decade for various parts of the Jura; contours were then constructed, every 100 metres apart, without any regard to the present topography, and a photographic proof of the map, reduced one-half, colored in the manner of an ordinary hypsometric map.[1]

The result is very striking: nearly everywhere a strict accordance is shown to exist between the actual courses of rivers and the distribution of the lowest parts of the constructional surface; the larger streams, those which might be expected to exhibit the most irregular courses if the assumption of an antecedent origin was correct, are precisely those which follow the most closely synclinal depressions, making use here and there of *cols* where anticlinal arches are locally lowered in a transverse direction. Such is the case for the river Ain, the longest among the tributaries which the Rhone receives from the Jura, and for the Doubs, the longest stream in the whole region. A beautiful illustration of a series of *cluses* arranged in a straight line, and demonstrably correlated with the lowering of several adjacent anticlines from both sides, is given by the river Bienne, between the town of St. Claude and its junction with the Ain. Many other cases might be pointed out to the same effect, viz.: that the Jura drainage, as a whole, is typically consequent upon the deformations, and that, accordingly, Professor Davis was quite right in postulating as the initial stage, in the development of Pennsylvania rivers, essentially original courses during Permian time.

As to the special case of the Birse, no doubt that apparent exception remains to be explained; that backward erosion may have been concerned in the production of the Bernese *Cirques*, Mr. Foerste himself seems to concede, in alluding to the Crémine cirque; and I believe nobody can have seen the Soulce depression, on the outside of the Choindez fold, or the great ravine south of Châtillon, a little more to the east, without being struck by the analogy of both features with an unperfected *cluse*—and their purely regressive origin is beyond question.

A last word about the crystalline pebbles in the Tertiaries of the Bernese Jura: Mr. Foerste, following J. B. Greppin, believes that they came from the Schwartzwald, to the north of the district. But that conclusion is far from certain. Dr. Rollier, who has carefully surveyed the district on the scale of 1:25,000,

[1] The method here described does not seem to have been, as yet, appreciated to its full value. Originated, I believe, in America, with Professor Lesley's efforts, and splendidly applied to the study of the anthracite fields of Pennsylvania by his lamented assistant, the late Charles A. Ashburner, it has been but little resorted to, outside of very limited districts and for purely scientific purposes. So far as I am aware, the only similar attempts yet made to construct in contour-lines stereograms of displacements, for a broad geographical area, are Mr. Dollfus's "Carte hypsometrique de la Surface de la Craie dans le Bassin de Paris," on the scale of 1:1,000,000, published in Bulletin No. 14 of the French Geological Survey (Paris, 1890), and the two maps illustrating the shape of the Trenton limestone in Ohio and Indiana, published by Professor Orton and Mr. Phinney in the Eighth and Eleventh Annual Reports of the United States Geological Survey, respectively. I myself constructed, several years ago, a contour map, still unpublished, showing the deformations of the Dakota sandstone in western Colorado (from Hayden's atlas of that state), and where the same agreement between structure and hydrography as is here advocated for the Jura was plainly exhibited. The construction of such maps would be specially fitting in those countries where detailed geological surveys are conducted upon topographical maps in contours as a basis, such as are in most parts of Germany.

when conducting five years ago the Swiss Geological Society on the ground, expressed the opinion, then endorsed by Professor Gutzwiller and Professor Baltzer, that the pebbles, at least in part, came, on the contrary, from the south and were of Alpine origin;[2] and it may be well to recall that such was also Studer's opinion.[3] It would make the case very different, in so far as several of the paleo-geographical conclusions of Mr. Foerste are concerned.

INDIANA ACADEMY OF SCIENCE.

The ninth annual meeting of the Indiana Academy of Science was held in the capitol at Indianapolis, Dec. 27 and 28, 1893, under the presidency of Dr. J. C. Arthur, of Purdue University. The morning of Wednesday was devoted to a discussion of the proposed biological survey of Indiana. The directors having the survey in charge first presented reports of their respective divisions. Dr. L. M. Underwood, Division of Botany; Dr. C. H. Eigenmann, Division of Zoölogy; Prof. V. F. Marsters, Division of Palæontology. For some time there has been under discussion a plan for several states to coöperate in the work of such a survey; This matter was taken up, and Dr. J. M. Coulter, of Lake Forest, Ill., spoke for that state. Prof. R. E. Call represented Kentucky. Several of the workers on the Indiana Survey spoke on various phases of the work. "Phænerogams," discussed by Prof. Stanley Coulter; "Fishes," Dr. C. H. Eigenmann; "Plans for Successful Work," Dr. J. M. Coulter; "What Can the High Schools Do to Help the Survey?" Prof. W. S. Blatchley. "Can the Common Schools Aid?" Prof. W. W. Norman; "Mollusks," Prof. R. E. Call; "Palæontology," Prof. V. F. Marsters; "Ornithology," A. W. Butler. The discussion occupied the full half-day.

In the afternoon the Academy met in two sections, one devoted to botany and zoölogy, the other to chemistry, physics and mathematics. In the former the following papers were presented: "An Alphabetical and Synonymical Catalogue of the Acrididæ of the United States," W. S. Blatchley; "On the Hibernation of Turtles," A. W. Butler; "Some Notes on a Variety of *Solanum Dulcamara*," R. Wes. McBride; "Indiana Fishes," C. H. Eigenmann; "Review of Botanical Work in Indiana with Bibliography," L. M. Underwood; "Notes on an Imbedding Material," John S. Wright; "Recent Notes on Indiana Birds," A. W. Butler; "The Distribution of Indiana Birds," A. W. Butler; "On the Occurrence of the Rarest of the Warblers (Dendroica Kirtlandi) in Indiana," A. B. Ulrey; "Histology of the Pontederiaceæ," E. W. Olive; "Growth in Length and Thickness of the Petiole of *Richardia*," Katherine E. Golden; "The Geographical and Hypsometrical Distribution of North American Viviparidæ," R. Ellsworth Call; "Recent Notes on Cacti," J. M. Coulter; "The Field Columbian Museum," J. M. Coulter.

In the physico-chemical section were presented: "Estimation of Organic Matter in Water by the Potassium Permanganate Method," Thos. C. Van Nuys and Sherman Davis; "1. 4. Di-amino-cyclo-hexane," W. A. Noyes and H. H. Ballard; "Preliminary Note on Variations of Strength of Timber in Different Parts of the Cross Section of the Tree," Thomas Gray; "A Method of Determining Traces of Cyanogen in Organic Matter," Sherman Davis; "Integration of a Linear Vector Differential Equation," A. S. Hathaway; "An Autographic Method of Testing the Magnetic Qualities of Iron," Thomas Gray; "A Case of Stereo-isomerism in the Hydrazones of Benzoin," Alexander Smith; "Camphoric Acid," W. A. Noyes; "The Value of the Steam Pipe within the Smoke Box of a Locomotive, as a Means of Superheating," Wm. F. M. Goss; "An Experimental Study of the Action of the Counterbalance in Locomotive Drive-Wheels," Wm. F. M. Goss; "Methods of Starch Determination," W. E. Stone and D. B. Hoffman; "The Combustion Gases of the Locomotive," W. E. Stone.

Wednesday evening the Academy met in general session. The following officers were elected for the ensuing year: President, W. A. Noyes, Terre Haute; Vice President, A. W. Butler, Brookville; Secretary, C. A. Waldo, Greencastle; Assistant Secretary, W. W. Norman, Greencastle; Treasurer, W. P. Shannon, Greensburg. President Arthur then addressed the Academy on "The Special Senses of Plants."

Thursday morning the early part of the session was devoted to the reports of committees. A change was made in the constitution of the Academy providing for a body of fellows. The following papers were then presented: "Should the Study of Natural Science in the Lower Classes of the Public Schools be Encouraged?" W. W. Norman; "The Detection of Strychnine in an Exhumed Human Body," W. A. Noyes; "Absorption of Poisons by Animal Tissue After Death," P. S. Baker; "The Application of Graphical Methods to the Solution of Some Problems in Electrical Engineering," Harold B. Smith; "Induration of Certain Tertiary Rocks in Northeastern Arkansas," R. Ellsworth Call; "The Effect of Environment on the Mass of Local Species," C. H. Eigenmann.

At the afternoon session the following papers were offered: "The White Clays of Southern Indiana," A. W. Butler; "The Ash of Trees," Mason B. Thomas; "Poisonous Influence of *Cypripedium spectabile*," D. T. MacDougal; "Notes on the Biological Survey," Mason B. Thomas; "Notes on Sectioning Woody Tissues," John S. Wright; "The Stomates of Cycas," Mason B. Thomas; "Symbiosis in Isopyrum Biternatum," D. T. MacDougal; "Our Present Knowledge of the Distribution of Pteridophytes in Indiana," Lucien M. Underwood; "Concerning the Effect of Glycerine on Plants," John S. Wright; "The Adventitious Plants of Fayette County," Robert Hessler; "Bibliography of Indiana Ornithology," A. W. Butler; "Bibliography of the Batrachians and Reptiles of Indiana," O. P. Hay; "Bibliography of Indiana Mammals," A. W. Butler and B. W. Everman; "The Effect of Light on the Germinating Spores of Marine Algæ," Melvin A. Brannon; "Notes on Saprolegnia," George L. Roberts; "Contributions to the Life-History of Notothylas," D. M. Mottier; "Some South American *Characinidæ*, with Six New Species," A. B. Ulrey.

The Academy decided to hold its next meeting in May at Rochester, Indiana, where, in connection with the meeting, an exploration of some of the beautiful lakes in that vicinity can be undertaken.

—Diana Clifford Kimber will soon publish a text-book on "Anatomy and Physiology for Nurses," in connection with Louise Darche. Miss Kimber's experience as assistant superintendent in both the New York City and the Illinois Training School for Nurses has led her to feel the need of such a manual and to undertake the work. It is designed to fill a middle place between the text-book written for medical students and that for use of children in schools. The subject is presented in a scientific manner, but the technicalities which discourage the average student have been, so far as possible, avoided.

[2] See Eclogæ Geologicæ Helvetiæ, 1888, No. III., p. 281.
[3] See L. Rollier, Etude stratigraphique sur les terraine tertiaire du Jura Bernois (Archives des Sc. Phys. et. Nat., March, 1892).

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THE CRUISE OF THE CLOVER—FURTHER REMARKS ON THE ABERRATIONS OF AUDIBILITY OF FOG SIGNALS—THE METHODS USED.[1]

BY ARNOLD BURGES JOHNSON, WASHINGTON, D. C.

IT is now about a quarter of a century since Prof. Joseph Henry, the first President of this society, commenced his investigation into the operations of the laws of sound in connection with the fog signals used by the Light House Board, of which board he was then the scientific member.

When I was made Chief Clerk of the Light House Board in 1869 it became my duty, as well as a privilege which I highly prized, to act to a certain extent as his amanuensis and aid in putting the results of his experiments in the form of reports to the Light House Board. In this way I became interested in this work and was, in a very humble way, associated with Professor Henry in its prosecution. Thus I entered with him into a practical discussion of the subject and became, after a fashion, possessed of his views as to the best way to follow up the investigation. I thus came to know something of his tentative plans and of his desire to make very practical use for light house purposes of the outcome of the investigations.

On Nov. 6, 1880, the great Long Island Sound steamer Rhode Island was stranded and finally lost on Bonnet Point in Narragansett Bay. Then, putting it roughly, a million in property was lost and thousands of lives were imperilled. The master and pilot of the steamer claimed that the fog-signal at Beaver Tail Point, about one and seven-eighths miles away, was not sounding at the time of the accident; and hence the casualty. The light keeper who was in charge of the fog-signal at the time, and who was in peril of losing his place, proved conclusively that at the time of the wreck the sound of the fog-signal was heard at Newport, five miles away, at Fort Adams, four and a quarter miles away in one direction, and at Narragansett Pier, four and a half miles away in another direction. The steamer people, who were in danger of forfeiting their licenses, came back with affidavits of many on board that they were anxiously listening for the fog-signal, and that it was not in operation, for they did not hear its sound.

Then the Light House Board took a hand in the matter. It had been shown by Professor Henry that, although a sound could be heard at a certain distance from its source, it might not be heard in the same direction, and at the same time, at a less distance. Could this be one of those cases? A naval officer in the service of the board, now ranking as a Commodore, was sent to the locality to find out. He had the fog-signal at Beaver Tail started, and cruised round it in a sail boat for some time, taking constant note of the intervals of the sound. He found, and reported to everybody's surprise, that not only did he fail to get the sound of the Beaver Tail fog-signal at Bonnet Point, one and seven-eighths miles away, where the Rhode Island was lost, but he failed to get it at other points even nearer to the fog-signal, while he heard it on the same day at different points farther away, and much farther away in a line with the nearer points where he could not hear it. This settled the question. The light keeper was relieved from the charge of failing to have the fog-signal in operation, and the steamer people were relieved from the charge of failing to act on the warning of the fog-signal, which was blowing, but which, while within earshot, they might not hear.

In 1881 the great propeller Galatea, while on the way from New York to Providence, ran onto Little Gull Island in Long Island Sound, imperilling many lives and much property. There was, and is, on that island, which is but one-eighth of a mile long, a powerful light and a powerful fog-signal. That fog signal has been often heard sixteen miles away. The defense of the steamer people was that the fog was dense and that the fog-signal was not blowing. The light-keeper, in his defense, showed that the fog-signal was blowing, that it was heard and noted at several different points in different directions, say at New London, Mystic, and at several light houses, many miles away, at the very time the Galatea ran on the little islet on which the fog-signal was at work. Again the Light House Board was required to look into the matter. Again careful investigation was made. And again it was shown that the fog-signal might be heard far off, and not close to, and the spots where it was not heard were noted and plotted on the chart; and again the steamer people and the light house people were exonerated from blame.

In 1881 I gathered these facts and submitted them to the Philosophical Society. My paper was printed in the Bulletin of the Society, and it was largely copied in maritime and scientific publications in this and other countries. The light house establishments of England, France and Spain reprinted the paper, each in its own language. And the eminent Emile Allard, head of the French light house establishment and a prominent officer of the French Corps of Engineers, plotted my numerical statement of the intensity of sound as heard from the fog-signals, in graphic form, that is, in lines of various width, and sent his diagrams to me in a letter in which he discussed the subject at length.

The Light House Board meantime was considering the matter from a purely practical standpoint. If, it was reasoned, there is a point within earshot of a fog-signal, where, from any cause, the fog-signal cannot be heard, then some other signal should be placed at that point, from which vessels can take a fresh departure. Acting upon that idea, investigation was made as to the region about each prominent fog-signal which it had been said could not be heard at points where it ought to be heard. In several instances I was sent to such points to make investigation and to report with recommendations. In the summer of 1885 I cruised about Point Judith, R. I., and the southeast end of Block Island, both at the entrance of Long Island Sound, and about the light house and fog-signal on Little Brewster Island, entrance to Boston Harbor. An area of silence was found and plotted about one and a quarter miles south of Point Judith, where the

[1] Read before the Philosophical Society of Washington, Nov. 25, 1893.

powerful fog-signal in operation at Point Judith could not be heard. That area was soon marked by a whistling buoy. A similar area was found and plotted five miles from Block Island, and a whistling buoy was placed in the centre of that silent spot.

A curious state of things was found off the light house on Little Brewster Island, Boston Harbor. Complaint had been made as to the action of the fog-signal there, which was a Daboll trumpet, and another and better fog-signal was wanted. Some asked for a siren, some for a steam whistle, and some for a larger and better Daboll. So a battery of fog-signals, one of each kind, was placed there, and I was appointed, with others, on an informal sort of a board to ascertain and report which of the three was best adapted to the place. It was found that the siren gave the best effect, and it was duly established there, and is there yet. But it was also found that there were several areas of silence within normal ear-shot of that fog-signal which were constant as to their general position, but which were floating or variable in their actual positions. There were already so many lights, buoys, spindles, etc., in that vicinity it was recommended that no more be established there lest it cause confusion. It was deemed the most curious concatenation of peculiar phenomena yet met.

In observing all these peculiar phases of non-audition of fog-signals at points where they should be heard, only one vessel had been used at a time. Hence, we had no record as to the sound at more than one place at a time, of a fog-signal. It had been a favorite plan of Professor Henry to use several vessels simultaneously about the same fog-signal, so as to learn where its sound was heard, as well as where it was not heard, at the same moment. The board decided to follow that plan this fall and in this way to re examine, with several vessels at the same time, the sound of the fog-signal, which had heretofore been examined with but one vessel at a time.

This duty was devolved on me, and I was ordered to the Clover, a fast-sailing schooner, to carry it into effect. I was permitted to invite two members of this society, Prof. C. A. White, LL. D., Member National Academy of Sciences, and Prof. H. A. Hazen, Forecaster of the Weather Bureau, to go with me on this cruise, and the invitation was afterwards formally repeated by the board. It was planned that when I had reached a scene of operation and a proper day was found, I was to impress any other light house vessel within reach for that day, and the light house district officers were directed to give every practical aid to the expedition. This they did with great readiness and good effect.

Thus it has happened that observations have been made recently from three vessels simultaneously, at three different places, of the sound of a number of fog-signals at which abnormal phenomena had been observed and reported before; and the recent observations have been made, and have been plotted on the same scale as previous observations; so that all the observations made at each place whether in 1881, 1885 or 1893 are now comparable.

The methods used at Little Gull light house and fog-signal station, for instance, were as follows:

The Clover arrived at New London Harbor on the morning of Oct. 19. Leaving her trying to work up to the city, against a headwind, I went ahead in the steam launch. At the light house depot I found the light house steamer, Cactus, with banked fires. In half an hour she was under way, and towing the Clover toward Little Gull light station. Dr. White, Professor Hazen and I went on shore and the light keeper was directed to start up his fog-signal. Dr. White remained on the islet to see that the orders were carried out and to note any variations made from any cause in the usual sound. Then Professor Hazen went on board of the Clover and I returned to the Cactus, and each vessel ran over prescribed courses. Observations of the intensity of the sound were made on each vessel each minute. The direction and force of the wind, the temperature by wet and dry bulb thermometer, and the pressure of the atmosphere, as shown by the barometer, were duly recorded. The appearance of the sea and the sky were also noted.

The next day the Cactus was engaged on other imperative duty and the Clover went out from New London Harbor, where we had spent the night, without her. But Professor Hazen made a rather adventurous cruise in an open steam launch about the fog-signal, with excellent results.

On the third day Professor Hazen was on the schooner Clover, and I was on the steamer Cactus. Dr. White was landed on Great Gull Island, which is small, treeless, and uninhabited, where he had large opportunity, which he fully used, to get the sound of the fog-signal under circumstances not had before. Here Dr. White noted the action and the result of peculiar echoes, and his studies of these echoes have developed an important factor in the discussion.

Off Point Judith we had very light wind, almost no sea, though there was a heavy swell rolling in, and a fair sky; in other words, we had an excellent day for hearing.

The Cactus being again with us, I went on her, Dr. White stayed with the Clover, and Professor Hazen, in spite of the bad character of that vicinity for quick and severe changes of weather, again took to the steam launch; so we got simultaneous observations of the sound of the fog-signal at Point Judith from three vessels, each cruising about on different lines.

In our work about the light on Little Brewster Island, at the entrance to Boston Bay, which occupied two days, we had the help of two other steamers. Major Livermore, of the Corps of Engineers, U. S. A., and Engineer of the First and Second Light House Districts, went with us on his steam propeller, the Myrtle, and Lieutenant Commander Colby, U. S. N., assistant to the Inspector of the Second Light House District, accompanied us on the side-wheel steamer, Geranium. On the first day I was with Major Livermore on the Myrtle, Dr. White was in charge of the work on the Clover, and Professor Hazen went with Lieutenant Commander Colby on the Geranium. On the second day Dr. White went with Major Livermore; I stayed on the Clover, and Professor Hazen remained with Lieutenant Commander Colby on the Geranium. Each vessel ran on different courses on different days, and we got many simultaneous observations from the three vessels. Most of the time was spent on the open ocean between Boston light and Minot's Ledge light, or beyond, or between Boston light and Egg Rock light. Part of each day, as we were going and coming from Boston Harbor, was spent in the Narrows, or in Broad Sound, at the rear of the fog-signal we were observing.

Now, as to our tools. We had on the Clover an anemometer at the foremast head, and another at the end of the jib-boom. Both were connected by electric two-conductor cables with self-registering apparatus in the cabin. We also had a barograph which registered the pressure of the atmosphere, and we had a very delicate barometer by which to check the barograph These had been lent to the expedition by the Weather Bureau, and were under the charge of Professor Hazen, who looked after our meteorology. In addition to these, the Professor had brought his own sling pschycometer, an ingenious arrangement of wet and dry bulb thermometers, which he managed with great skill, and clung to with much affection. The Clover had her own complement of thermometers, barometers, etc., in addition to what had come to us from the

Weather Bureau. The balloon which the Secretary of the Treasury had asked the Secretary of Agriculture to permit the Weather Bureau to lend us, and which had been shipped to us, did not arrive. Had it come we might have had Professor Hazen looking down upon us from a great height, and we should have had him at the end of a rope, recording temperature, air currents, moisture, wind and sound from 1,000 feet above, and at intervals of 25 feet, till we landed him on our deck or in the water. Major Livermore, however, used toy balloons, with which to ascertain the force and direction of the upper air currents. The paper balloons were, say, four feet high, and one foot in diameter, at the widest part. They had an ingenious attachment for producing hot air, which, at night, lighted them, and made them for a while clearly visible. The longest flight I saw one of these make was 15½ minutes. Then the Major had spherical rubber balloons of, say, nine inches through, which he filled with hydrogen generated on the Myrtle, which were also quite useful.

The fog-signals we were sent to observe were three steam sirens and a steam whistle. Each signal has its own peculiar characteristic. The second-class siren at Little Gull Island, for instance, gave, during a fog, a blast of five seconds, and then after a silent interval of 40 seconds, and another blast of five seconds, and it continued this alternation of blast and interval while the fog continued. This blast and interval served to differentiate this signal from other signals within ear-shot, and especially that at New London light-house, which was a six seconds blast, alternating with a silent interval of thirty seconds.

The siren is the most powerful fog-signal in existence. The English Government adopted it after a favorable report on it made by a commission sent to this country headed by Sir Frederick Arrow, and also after a report by Professor Tyndall, who then bore the same relation to the English lighthouse establishment that Professor Henry did to the United States lighthouse establishment, that is, of scientific adviser.

Tyndall says of the siren in his book on "Sound," third edition, p. 316: "The steam siren is the most powerful fog-signal which has been tried in England." Again Tyndall says on p. 318: "We find the sound range on clear calm days varying from 2 1/2 to 16 1/2 miles." Again he says on page 319: "It may be relied upon at a distance of two miles; in a great majority of cases it may be relied upon at a distance of three miles, and in a majority of cases at a distance greater than three miles."

Now as to the full range of the instrument, Tyndall says on page 321 of the same book: "The most conflicting results were at first obtained. On the 19th of May, 1873, the sound range was 3 1/3 miles; on the 20th it was 5 1/2 miles; on the 2nd of June, 6 miles; on the 3rd, more than 9 miles; on the 10th, 9 miles; on the 25th, 6 miles; on the 26th, 9¼ miles; on the 1st of July, 12¾ miles; on the 2nd, 4 miles; while on the 3rd, with a clear, calm atmosphere and smooth sea, it was less than 3 miles."

I have quoted this much from Tyndall, for while he accepts the siren, he damns it with faint praise, and what he says is about the worst that has been said of it. The French, who also adopted it, speak in much higher terms of it, and the Light House Board, while constantly searching, has found nothing better. It remains the best fog-signal in the world, and it may be regarded as a constant memorial of the work of Professor Henry, who, for light-house purposes, was its inventor.

But good as the siren is, it leaves much to be desired. It is a great big clumsy, ugly machine, expensive to make, expensive to run, and expensive to keep in repair. It is maintained to make a great big ugly noise continuously, and of a certain kind and at certain intervals. It makes the noise, without regard to ethics or esthetics; but it might keep its pitch better; and it might maintain its intervals better. It is not an instrument of precision. It has its limitations. They are not entirely unconnected with the pressure of its steam; in other words, with its management. But it approximates exactness sufficiently near to answer the purposes for which it is intended. When the mariner hears it, and hears it aright, he knows where he is. The question we are discussing is not so much connected with the sound made as with the sound heard. It is not the aberration of the sound, but the aberration of the audition of the sound with which we are concerned.

Now as to the method used to determine the intensity of the sounds of the fog-signal we tested. This we did, on this cruise, by ear, and on the same scale and in the same way in which it was done in observations made in 1881 and 1885.

Each of the party on the Clover used the scale of 10. It was understood that 10 was the sound of the highest intensity, and 0+ the lowest sound observable. We divided the scale, however, thus: 1 1 plus, 1½, 2 minus, and then 2. Mr. Wallace, Major Livermore's assistant, used the scale of 100. I have no doubt that is just as good as my scale, but as I had commenced my observations on the scale of 10, I carried that scale through these observations in order that those made in '93 might be comparable with those made in '85 and in '81. The question of personal equation has arisen, but I have carefully avoided any comparison of the mode of hearing, or rather accuracy of hearing, between members of my party. My direction to each was to record 10 as the highest sound of the fog-signal that could be heard on board of the vessel in which he was making observations. When they were as near as they could get the vessel to the source of sound, the distance was, as a rule, not more than one-fourth of a mile. The minimum sound was 0. plus. One-half of the sound between 0+ and 10, I considered as 5, and half-way between that and maximum was called 7½, and half-way between 5 and 0+ was regarded as 2½, and then we divided still finer between those points. In that way I think we got a practical solution of the question, and are as nearly accurate as it is practicable for observers to be, that is, for practical, but not for scientific, purposes.

Each person preserves his own scale throughout, recording the maximum and minimum and medium, and dividing between those points according to the accuracy of his own ear. I noticed that different members of my party, and of Major Livermore's party, did not mark instances the same under some circumstances; but the differences were slight, and they could be accounted for by interfering noises in different parts of the ship, which affected different hearers in those parts of the ship, so that their hearing of the same noise was to a certain extent interfered with. I think the results reached were of a practical character, although they were not such as might be considered severely, or even scientifically, accurate. They were not such as would have been recorded by a self-registering machine, that is, they were not as finely phrased. I tried to put myself in the place of the mariner, who might hear a fog signal without knowing what it was, and who might be forced to determine its identity by the character of its blast, the intensity of its blast, and the continuation of the silent interval between blasts.

Major Livermore has a large number of observations which have been plotted, and I think will be comparable with ours when ours are plotted.

We are now having very delicate instruments made with which to measure the character and the intensity of the sounds made by fog-signals; and thus I hope that

next year we may be able to give the intensity of the sounds heard, with an approach to absolute accuracy.

The results thus far obtained, however, are such as a captain of a vessel coming onto our coast in a fog and a gale would be apt to get. It is for him the fog-signals are established, and I have tried to put myself in his place and to hear with his tired and strained ears the sounds which must be distinguished and differentiated from the shrieking of the wind, the creaking of the cordage, the rattle of the machinery and the roar of the surf.

If he has heard aright the sound of the fog-signal and can tell from the length of its blast and the following interval of silence which one of the several fog-signals in that vicinity it is, he is certain of his position.

The experiments thus far made and the observations taken are to make sure that the mariner can hear aright what he does hear, and to provide against his acting upon errors in hearing, which, if acted on, may place his ship in peril.

SASSAFRAS TREES.

BY WALTER J. QUICK, COLUMBIA, MO.

As being of some scientific interest, it is worthy our attention to note the marvelous growth that ten trees of the above well-known variety have acquired here in Missouri—a growth that is so exceptional of this species that it has not been observed elsewhere in the United States.

The *Sassafras officinale*, of the order *Lauraceæ*, the Laurel family, is very seldom known as little more than a shrub or bush and generally as growing poorly or not at all on fertile soil. In truth, it is looked upon as being in its native element in company with and growing on thin land. This is not a fact, but the opinion prevails since old and worn-out fields, depleted of their fertility in greater part, when abandoned, grow up to "brush," not the least profuse of which is the sassafras. It is a native of America and has been found in every State in the Union, growing much more abundant on poverty-stricken soil, but more luxuriant and larger in proportion, we conclude, as the per cent of humus in the soil increases. In the poor, white clay lands of the New England States and some parts of Indiana, Kansas and this State we have observed it growing where it seems to sprout profusely and does not reach a height of over twelve feet, usually six or eight feet, while in the same States on richer land it will not be found in thick profusion, but scattered and attaining almost to the dignity of a tree in size.

Recently it was our pleasure to visit the beautiful farm of Mr. T. B. Hickman, near Columbia, Mo. During our stay we were shown the various interests of the owner, and our attention was summoned to some peculiar trees of the sassafras variety. Their difference from others of this species consists in their vigorous growth and extreme size, being the largest any one present had ever seen or of which we had in any way known. This preternatural development inspired us to investigation. They exhibited on measurement the surprising circumference of 80 to 82 inches—a diameter of over 26 inches. As the bark is thick and rough, similar to walnut, the diameter of the solid wood is not likely this much, but fully two feet. By triangulation we ascertained the height to be about fifty-five feet, and the whole ten will not vary much from these measurements.

While there is very little indication of decay, as a matter of fact, these trees are fully grown for this variety. Their location is very auspicious for the growth they have made, being the low, rich and moist soil of Bonne Famme creek bottom. The writer has never seen larger trees, and is unable to learn of larger specimens on this continent, with the exception of the species of sassafras of California and the western slope of the Rocky Mountains, known as *Oreodaphne Californica*, which attains a still larger size "in the land of big trees." The aroma from the leaves of this variety is more pungent, in fact, so much so as to occasion excessive sneezing, frequently during high winds. It has a greater reputation medicinally than ours, though the importance of the latter is by no means small.

Our *officinale* species has been introduced into England as *Sassafras laurus*. As is usual with anything imported, they appreciate it more as medicine than we do. A tree near the Royal Gardens at Kew has attained a height of about fifty feet, and is said to be over 110 years old. As there are no other figures given, we cannot compare the size with that of the Hickman trees, but the height is not so great.

Almost every country has one or more species of this tree, all said to differ in some characteristic from ours, but all having the same odor and similar aromatic, sweetish taste. But one country has larger trees. Those of New Zealand grow to a height of 100 to 150 feet. This tree appears in every clime, and is described as having "a large head of horizontal branches." The fruit is a small, black drupe, which is not palatable, but is eaten by birds. The sassafras oil of commerce is made from these seeds and the buds. The leaves of our species are very dark green, rather thick, broad, oblong and elliptical.

In Italy it is more like the American species than any other, and is known as *Sassafrasso*. The word comes from the Latin, *saxum*, a stone, and *frango*, I brake, so named because it was believed that the use of the tea made from it would desolve the gall stones of the bladder and prevent their formation.

In the southern states sassafras grows to the size of trees, generally small, but very abundant. The air is said to be more pregnant with its aroma than further north, and it can be detected a great distance at sea. The bark seems to be more fragrant, too, when steeped.

Sassafras tea is very popular in many sections of the countries where the tree grows. The bark of the roots is kept everywhere for sale, for that purpose. In addition to its use as a table beverage it is employed as a tonic and constitutional stimulant. In those localities where the sugar-maple tree is a native and abundant a very delightful drink is made from the "sugar-water," or sap and bark of the sassafras root. It makes the finest tea in the spring when the sap is forming and is then drunk mostly to resuscitate the system, improving the appetite and aiding the digestion. It is also valuable for boils, pimples and eruptions of all sorts, as well as for rheumatism.

The pith of the new growth and sprouts contains a gum or mucilage, used in eye medicines, as being important in reducing inflammation and granulations. This product is also prepared in the form of a drink for diseases of the kidneys, catarrhal troubles and dysentery.

In many localities there is perhaps no more popular farmers' remedy for diseases of horses. It is administered by grinding the root bark to a powder and giving it in the feed, or by preparing a decoction with which the feed is mixed. Frequently the roots are placed in the horse's feed trough, and he is permitted to bark them himself, which he willingly does, apparently with much relish. In the spring it greatly improves his appetite, strengthens him and assists in shedding and sleeking his coat.

THE McMILLAN CHEMICAL LABORATORY.

BY DELOS FALL, ALBION, MICH.

This building, the generous gift of Senator James McMillan, is now completed and will be devoted exclusively to the Department of Chemistry. It was dedicated Nov. 15 with appropriate exercises, addresses being delivered by Professor A. B. Prescott, of Michigan University, Professor H. H. Donaldson, of Chicago University, Senator McMillan, Professor Washington Gardner and others.

The plans were drawn by Mr. E. W. Arnold, architect, of Detroit; the building was erected by the firm of Wallace & Morris, builders and contractors, of Detroit.

of galvanized iron. The foundations are of stone. From the ground to the first story window-sill, the outside is faced with cut stone ashlar in courses.

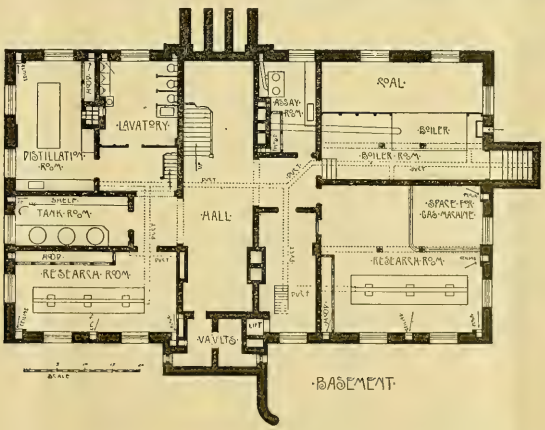
The exterior treatment is colonial in character, which will give to the building a quiet dignity and, at the same time, perfect appropriateness to the purposes for which it is erected.

The basement story is 10 feet high and contains a boiler and fuel room, an assay laboratory with three furnaces and a fire table; a hall, a fire-proof storage vault; a research room, fitted with tables, ventilating hoods, etc.; a room for large gas tanks holding oxygen and hydrogen; a distilling room, with fire-proof tables, hoods, etc.; a

The cut of the exterior and the floor plans here presented will give the reader a general idea of the structure. The general form of a building that would best suit the requirements of the various departments was found to be a rectangle, 52×88 feet. This is divided into two parts in each story by a hall 13 feet in width. This provides a wide, recessed entrance on both sides of the building.

lavatory, a storage room, and a second large research room.

In the first story, which is 13 feet high, there is, on one side of the hall, the organic laboratory, 27×30 feet, containing tables for 24 students, with 29 feet of hoods, also wall tables, cases for chemicals, etc. Adjacent to this is the quantitative laboratory, 22×30 feet, with tables for 20 students, hoods, wall tables, etc.; a combustion room,



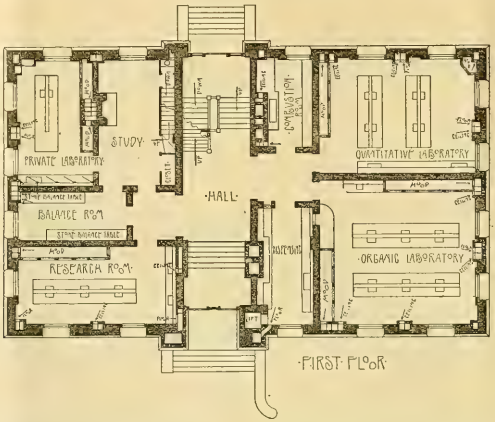
There are three stories and a basement, all abundantly lighted by high and broad windows.

All outside and inside walls are of brick. The entrances, sills, lintels, copings, etc., are cut stone, the cornices

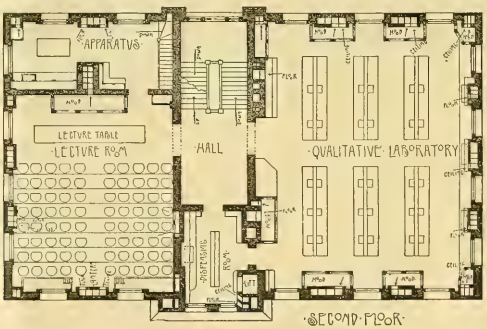
10×17 feet, and dispensing room, 10×21 feet.

On the other side of the hall is the instructor's study with a private stairway to the basement and the lecture room above. This is furnished with book cases, fire place,

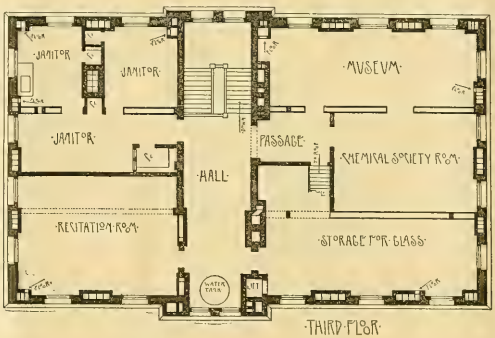
wardrobe, etc. Off this is a private laboratory, with large table, hoods, wall tables, cases, etc. The balance room, 9 × 21 feet, and a research room, 15 × 30 feet, complete the equipment of this floor.



The second story is also 13 feet high and contains the qualitative laboratory, 40 × 49 feet, with tables for 80 students, with 7 hoods, wall tables, cases, etc. The lecture room, also on this floor, 30 × 37 feet, will accommodate 82 students, the seating being arranged in rising tiers of chairs. This room also contains an elaborately furnished lecture table, provided with a large pneumatic cistern, a powerful down draught for handling noxious gases, wash bowl, gas, water and waste pipes at convenient intervals, hydrogen and oxygen from the tanks below, electric connections with dispensing and assistant's rooms, a plunge battery, etc.



Behind the lecture table is a hood 14 feet long, double counter-balanced blackboards, a rolling stereopticon curtain, etc. Off the lecture room is an apparatus and preparation room, which will also contain cases for lecture table apparatus.



The third story is 10 feet high and contains a chemical museum, a class room, a chemical society room, three rooms for janitor's residence, store rooms, etc.

The heating is by steam, direct radiation, and in addition to this there are encased radiators recessed under the windows with register openings through the wall. By this means a supply of warm, fresh air is admitted to each room, which can be fully controlled.

The ventilation is by large ventilating flues and groups of flues arranged so as to ventilate all parts of the building and at points where most needed. The flues are in three sets, viz.: for floor ventilation, for ceiling ventilation and for hood ventilation, each set independent of the other and yet each working in combination with the other, and all controlled independently. Steam heat is applied in all flues in the upper story, which will insure their proper working.

The Laboratory is supplied with gasoline gas from a machine of 400 Bunsen burner capacity. Each student's table is provided with two gas and two water cocks, wash bowl, two drawers, cupboards and shelves. The gas and water are also distributed to all hoods, dispensing rooms, etc.

THE GRADUAL DISAPPEARANCE OF THE RANGE GRASSES OF THE WEST.

BY I. W. TOURNEY, TUCSON, ARIZ.

In the early days of our great West almost the only method of travel from the Mississippi Valley to our western coast and intervening points was by caravan. Wagons drawn by horses or cattle were several months in making this journey. During this time the stock subsisted entirely upon the natural forage afforded by the country traversed. For the most part, this forage was perennial grasses, which at that time were everywhere abundant. Then the whole of the West was a great pasture, unstocked, save for the herds of buffalo, deer and antelope. Many regions which were covered with a luxuriant growth of nutritious grasses are now entirely destitute of vegetation, if we exclude a few straggling, stunted bushes and the yearly crop of annuals which follow the summer rains. As a more specific case, the rancher who drove the first herd of cattle into Tonto Basin, in central Arizona, found a well-watered valley, everywhere covered with grass reaching to his horse's belly. In passing through this region a year ago scarcely a culm of grass was to be seen from one end of the valley to the other. This transformation has taken place in a half-score of years.

The important native forage grasses are perennials, many of them of the great western genus *Bouteloua*. Their growth in all parts of arid and semi-arid regions is slow. The grasses which formerly covered so great an area of our West were years in developing their root systems, and, in not a few species, even the culms were of several years' growth. When only cropped by the deer and buffalo they were able to hold their own against the drought and other agencies of nature. By stocking this great western country with the herds of civilization, these grasses were mowed down before them like timber before the forest fire. They are gradually becoming less and less, and it is only a question of a few years when, in many regions, they will disappear as a material factor in the natural forage of the country. Regions long distances from water, out of reach of the great herds of cattle everywhere on the un-fenced domain of each western state and territory, are yet well-covered with perennial grasses. Last year in passing over a large unwatered area north of Prescott miles of country were found covered with grass, while in much more favored localities in the vicinity of water these species have entirely disappeared.

Cattle men are putting down wells in many of the unwatered regions and moving their herds thither. The first year the forage is excellent, the next year it is not so good, and the third or fourth year it becomes so poor that the well is abandoned and another sunk in an as yet unfed locality. The more arid the region the more disastrous is the effect of overstocking. When stock are driven into a locality they are allowed to increase, not in proportion to the amount of forage that the given range is in condition to furnish year after year, but as many are grazed as can find feed for the time being. No consideration or thought is expended on the future. This condition of things has been most disastrous to stock-men throughout the West. To within a few years the efforts of cattle-men were expended in increasing the size of their herds, and this continued until nearly every vestige of the perennial grasses was swept away. Since that time cattle have died by thousands, the assigned cause in most cases being cold weather or drought, when in reality it has been the lack of forage; the direct result of stocking the range to a greater extent than the natural conditions year after year will justify.

Many are deceiving themselves in thinking that a few rainy seasons will bring back the rich perennial grasses of the years gone by. It seems to me, under the present condition, the time can never come when our western range will be as rich in forage as it was ten or more years ago. Under the most favorable conditions, with cattle entirely excluded, it would take many years for these grasses to get the foothold that they formerly held.

The annual grasses, mostly the smaller *Boutelouas* and *Aristidas*, are not so disastrously affected by overstocking. They seem to be always on hand to cover the plains with verdure after the rainy seasons. They furnish excellent forage during the short period that they are at their prime, but at the most they can only provide feed for three or four months of the year. The ranchman makes a marked distinction between the annual and perennial grasses. He aptly designates the annual as "seed grasses" and the perennial as "root grasses." The seed grasses soon become worthless, their bleached, short culms are broken and beaten into the sand by storm and wind. The root grasses retain their vitality and remain green for the greater portion of the year. Even when dry, their harder, stronger and larger culms contain as much nutrition as well-cured hay, and are, or rather used to be, the valuable winter forage of the West.

In conclusion, there is a limit beyond which no range can be profitably stocked. If we exceed this limit it will not only be detrimental to the permanency of the range, but in the end will be disastrous to the stock as well. It is but natural that a growth of top is necessary to a growth of root, therefore if the tops be continually cropped to the ground, the roots will finally perish. This is especially true of grasses of arid regions, growing in bunches or scattered about here and there a few culms in a place. The range is frequently fed so close that few of the better grasses mature seeds, while many others are tramped out by horses and cattle. During the past few years the effect of over-stocking has shown itself in the inferiority of the cattle when compared with those of former years. They are poorer as a consequence of their increased number and the resulting deterioration of the range.

—The essays received by the Canadian Institute in the competition for a prize for the best act "which, if made law, would give the whole Canadian people equal representation in Parliament," have been issued to the final tribunal of judges. Their reports are returnable on March 15 next; immediately thereafter the awards will be announced.

MEETING OF THE IOWA ACADEMY OF SCIENCES.

THE eighth annual session of the Iowa Academy of Sciences occurred in Des Moines, Iowa, Dec. 26 and 27, 1893, and was one of the most largely attended and profitable in the history of the Academy. About thirty Fellows were in attendance, and over forty papers were presented.

The officers elected for the coming year were: Dr. L. W. Andrews, President; Prof. H. W. Norris and Dr. C. R. Keyes, Vice-Presidents; Herbert Osborn, Secretary-Treasurer; and Professors Arey, Hendrixson and Nutting additional members of the executive committee. Dr. L. W. Andrews presented a paper on the "Assumption of a Special Nacent State," in which he concluded that the assumption of such a condition is the survival of an obsolete doctrine and that it explains nothing which cannot be as well explained without it. In another paper he treated of some peculiarities of Ferric Sulphocyanate, discussing them from a physico-chemical basis.

Prof. A. A. Bennett made a verbal report upon certain work done in the Chemical Laboratory of the Iowa Agricultural College and called attention to the methods in vogue in instruction in chemistry.

Prof. W. S. Hendrixson, of Grinnell, Iowa, discussed "The Electrolysis of Silver," detailing a method by which pure silver could be obtained in a rapid and easy way, and, in another paper entitled "Some Laboratory Apparatus," he described several inexpensive forms, one of which was for the distillation of water.

Prof. G. W. Bissell presented some notes on experimental engineering at the Iowa Agricultural College, giving the results of some studies, the result of which can be used to advantage in the designing of certain kinds of machinery.

Prof. S. Calvin, of Iowa City, discussed the "Geological Position of Benettites Dacotensis, MacBride," with observations on the stratigrophy of the region in which the species was discovered. This was a careful description of the geological features of the region of Hot Springs, South Dakota, with the conclusion that this fossil belongs to the Cretaceous.

Dr. C. R. Keyes read a paper upon the "Derivation of the Unione Fauna of the Northwest." He compared the faunæ of different river basins and discussed at length their relations and derivations. In discussing the paper Professor Shimek, of Iowa City, called attention to the similarity of the Unione Fauna of eastern Nebraska and eastern Iowa, whereas in central and western Iowa these forms are much less plentiful.

Prof. J. L. Tilton, of Indianola, discussed the "Origin of the Present Drainage System of Warren County." The present river valleys and larger ravines fit into the preglacial valleys, while in the smaller divisions only do we find erosion without regard to the pre-glacial configuration of the country.

H. F. Bain, of the Geological Survey, in a paper on "The Structure of the Mystic Coal Basin," presented data from a number of different sections, showing a remarkable persistence of character in the coal strata at different points, which has had a very important bearing upon the development of the coal industry of southern Iowa. In another paper he gave a careful record of the strata penetrated in the boring of the "Deep Well at Sigourney." These borings of nearly two thousand feet penetrated the various formations to the "St. Peters" and entered the Oneota.

E. H. Lonsdale, of the Geological Survey, in a paper entitled "Southern Extension of the Cretaceous in Iowa," presented the results of an extended examination of the southwestern portion of the State, in which he has been able to determine the occurrence of Cretaceous deposits at points considerably farther south than hitherto recognized.

A. G. Leonard, on the "Zinc Deposits of Northeastern Iowa," showed that these deposits have proven quite valuable and are being extensively worked, occupying the same localities as the lead deposits, which at one time were worked with profit, but have for a number of years been practically abandoned. He also spoke of "Satin Spar from Dubuque, Iowa," and exhibited some very handsome specimens of this mineral.

H. A. Jones, of Grinnell, Iowa, in a paper on the "Coal Measures in Powesheik County," indicated the location of coal seams and coal measure strata in the vicinity of Grinnell and at other points in the same county.

Prof. T. H. McBride, of Iowa City, presented some very interesting "Notes on North America Cycads," in which he described the occurrence of a remarkable new species of Benetites found in South Dakota. He also showed photographs of a large specimen of the fossil and a specimen of one of the living species for comparison. In another paper he discussed the "Distribution of *Rhus typhina*."

The presidential address by Prof. L. H. Pammell was devoted to a discussion of bacteria, their relation to modern medicine, the arts and industries. It was a very comprehensive and interesting account of the historical development of bacteriology and of the relations which these organisms bear to modern medicine and to various important industries. He also presented the following papers: "The Powdery Mildew of the Apple," "Further Notes on *Cladosporium carpophilum*" and "Notes from the Botanical Laboratory of the Iowa Agricultural College."

Prof. H. W. Norris, of Grinnell, in a paper on the "Development of the Ear of Necturus," presented the results of a very careful study of this organ and exhibited drawings of sections and also, for comparison, reconstructions of the ear of *Amblystoma*.

Prof. B. Shimek, of Iowa City, in "An Additional List of Iowa Molusca," recorded a considerable number of species additional to the list which he published some years ago. He also presented a paper and exhibited specimens illustrating the variations in certain Succinidæ occurring in the *loess*, comparing them with living forms and showing conclusively the great range of variation in certain species. He considers these shells an important factor in determining the age of the *loess* formations.

Prof. C. C. Nutting, of Iowa City, gave two anatomical papers, one devoted to the "Vascular Supply of the Teeth of the Domestic Cat," in which he showed that the distribution of the blood vessels to the teeth was different from what has been commonly held; the other discussed the "Homology of the Inca Bone."

Mr. Herbert Osborn, of Ames, presented a paper upon the "Distribution of Hemiptera," giving records which extend the known distribution of a number of species, also a paper including laboratory notes, in which he called attention to species particularly useful for laboratory work in this region.

Mr. C. W. Mally, in the "Hackberry Psyllidæ of Iowa," reviewed the species occurring in the state and gave very full descriptions of certain forms which had been studied in detail in their different stages.

Mr. F. A. Sirrine described "A New Species of Plant Louse Occurring on Thorn."

Aside from these papers, which were read, a number of others were read by title and will appear in the proceedings of the Academy, which will be published by the State at an early date.

Resolutions were passed commending the Geological Survey and, also, looking toward the securing of a greater amount of scientific literature in the State Library.

BALTIMORE MEETING OF THE AMERICAN CHEMICAL SOCIETY.

BY CHARLES PLATT.

After a rather dark period in its history, the American Chemical Society has now attained a firm footing, and has become what it has ever aimed to be, a truly national representation of American chemists. The summer meeting in Chicago and the recent Baltimore meeting have been extraordinarily successful, not only in papers presented, which are, after all, very secondary attractions, but more particularly in the establishment of those feelings of good fellowship and esteem which can only be born of personal acquaintance. During the last meeting this sentiment was expressed many times, and there was a universal feeling of congratulation and good-will, which made the meeting extremely satisfactory. The general verdict seemed to be that the time allotted was too short, and that a programme extending over three or four days, instead of the two provided by custom, would have been more suitable. The meeting convened Dec. 27, 1893, in the lecture-room of the chemical department of Johns Hopkins University, with President H. W. Wiley in the chair. President D. C. Gilman welcomed the society to the University, and Prof. Ira Remsen performed the same office in behalf of the chemical department. In response, President Wiley returned thanks for the society for the welcome so kindly extended, and, continuing, spoke of the remarkable growth of the society during the past year, its field in America, and the increasing need of such a bond of union as is provided. Professor Wiley then opened the business of the meeting with his presidential address on "The Relations of Agricultural Chemistry to the Waste and Recovery of Plant Food." Other papers on the programme, read in person or by title, were as follows: "The Widespread Occurrence of Barium and Strontium in Silicate Rocks," W. F. Hillebrand; "The Estimate of Small Amounts of Barium and Strontium in Silicate Analysis," W. F. Hillebrand; "A Plea for Greater Completeness in Chemical Rock Analysis," W. F. Hillebrand; "A Study of the Distribution of the Oleoresins in the 'Pinus Palustris,'" Omar Carr; "Salicylic Acid in Food," K. P. McElroy; "Utilization or Garbage," Bruno Terne; "Report on the Determination of Atomic Weights Published during 1893," F. W. Clarke; "The Detection of Strychnine in an Exhumed Human Body," W. D. Noyes; "The Importance of the Study of Biochemistry," E. A. de Schweinitz; "Upon Uniformity in Sampling and Assaying Copper Bullion," G. W. Lehmann; "The Preservation and Arrangement of Chemical Abstracts," Thomas M. Chatard; "Notes on the Electro-Metallurgy of Zinc," Charles Platt; "The Phenyl-hydrazen Test for Glucose in Urine," C. E. Pellew; "Expert Testimony," W. P. Mason; "A Description of the Boric Acid Springs in Tuscany," W. P. Mason; "Phosphorus in Steel," C. B. Dudley; "Determination of Phosphorus by the Molybdate Method in the Presence of Arsenic in Iron, Steel and Ores," J. O. Handy; "The Analysis of Malt," J. A. Miller.

Other papers not on the programme were presented, among them one by Dr. Thomas Taylor, of Washington, and another by Prof. G. F. Baker, of Philadelphia, who read a memorial to the late T. Sterry Hunt.

In the afternoon the society accepted the invitation of the Baltimore Copper Smelting and Rolling Company, and several profitable hours were spent examining the details of refining at these representative works. A complimentary banquet was enjoyed at the Eutaw House in the evening. On the second day the reading of the papers was continued and the annual business of the society transacted. The officers elected for the ensuing year are: President, H. W. Wiley; General Secretary, Albert C. Hale; Treasurer, C. F. McKenna (resigned); Librarian, F. E. Dodge; Directors—C. F. Chandler, P. T. Austen, C. A. Doremus, H. C. Bolton; Council—C. B. Dudley, C. E. Munroe, Wm. McMurtrie, J. H. Appleton. The meeting was brought to a close with a delightful excursion down the river to Sparrows Point, where the works of the Maryland Steel Company were thoroughly inspected.

LETTERS TO THE EDITOR.

***Correspondents are requested to be as brief as possible. The writer's name is in all cases required as a proof of good faith.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

DO EARTH WORMS RAIN DOWN?

The old-time notion that earth worms, frogs, fish, etc., "rain down" is now seldom mentioned by intelligent people except in the way of ridicule. The sudden appearance of these animals after a shower is, however, a matter of common observation, and I am not aware that any adequate explanation of the phenomenon has ever been given.

I have heretofore mentioned the finding of minnows after a heavy rain in pools and ditches which were dry not long before. As for earth worms, their nature and habits seem to preclude their coming to the surface voluntarily. When dug up and left on top of the ground they seem very uncomfortable and lose no time in burying themselves again, as soon as they can find a spot where the earth is soft enough to penetrate. Of those found after a rain, some are dead, others nearly so, and those which are in motion seem plainly to be seeking a place to burrow. While it would seem to be impossible that they should have come down from above, it is very remarkable that they should come up from below, leaving their dark, earthy home to be pelted by the rain, which seems so disastrous to them. Besides, they are often found in situations which they could not have reached from the earth, as in tightly cemented cisterns, closed with no opening except where the water pipe enters from the roof. Have those found drowned in rain barrels committed suicide by crawling up the side of the barrel and thence into the water? By the way, who can vouch for their ability to climb a vertical surface in that way?

This morning, after a shower, I found several earth worms near the middle of a street paved with asphalt. There was no crack or crevice in the pavement, and it connected smoothly, on each side, with a curbstone six-and-a-half inches high. It would seem entirely contrary to nature for them to leave the soft earth, climb over the curbstone and make the long journey to the middle of the street.

I have no theory or explanation to offer. My relation to the subject is merely that of an interested observer. I would be glad if others would contribute their observations, with a view to arriving at the true explanation.

CHARLES B. PALMER.

Columbus, Ohio.

LATE-BLOOMING TREES.

Dr. Walter Mendelson inquires in *Science* for Dec. 15, 1893, as to "cause and effects of late-blooming of fruit trees." The fruit buds of pears, peaches, apples and cherries are formed during the late summer and early autumn. If there should be warm, damp weather in the autumn, premature blossoming is frequently caused, and the result is the fruit crop of the following

season is diminished in proportion, as, of course, no new buds can be formed.

This late blooming is not at all uncommon, although I do not remember having noticed any as early as September. One season in the first week of November the pear trees in the garden were quite white with blossoms, but unfortunately I cannot recall the year.

Dr. Mendelson may enjoy a very pretty bouquet in February or March by placing in water in a sunny window the fruit-bearing branches of pears, apples or cherries; in a short time they will develop their beautiful and fragrant blossoms. F. J. THOMPSON.

New Brighton, Staten Island.

A CORRECTION.

Science is so generally exact in following copy that I must have left out one important word in a recent communication. I should have said that the *early* Iroquois had no council wampum. When the Dutch came they obtained it fast enough, but it is found on no earlier sites in their territory. The later ones have furnished it in abundance.

I wish to record the occurrence of the thick-billed guillemot in this part of New York. A young one was shot on the Seneca River, at Baldwinsville, Dec. 15, 1893. It has not been reported so far inland before. Two species of cormorant have been shot on Onondaga Lake, and I heard that a pelican was recently killed there, but have not seen it. W. M. BEAUCHAMP.

Baldwinsville, N. Y., Dec. 28, 1893.

LATE-BLOOMING TREES.

TREES or shrubs if stripped of their foliage during the summer will put out new buds and new leaves and blossoms. It is a common saying with farmers that when a tree blossoms in the fall it is about to die, which is generally the case, as it mostly occurs on diseased trees. On such a tree the leaves will often turn yellow and fall off during a dry summer. The later rains will put a little new life into it, and it will often put forth buds and blossom. The same occurs if healthy trees are stripped of their foliage during the summer.

The phenomenon of "the late blossoming of trees," referred to by Dr. Walter Mendelson in *Science* of Dec. 15, 1893, was observed here. During the latter part of September and the first of October great numbers of fruit trees were in bloom, and on many green fruit set and grew; but they all occurred in the track of a severe hail storm which in August passed over a strip of country about half-a-mile in width, cutting the foliage completely from the trees. Possibly Brielle and Alpine, N. J., were in the track of that hail storm.

THOMAS S. STEVENS.

Trenton, N. J., Dec. 28, 1893.

AS TO FEIGNED DEATH IN SNAKES.

WHILE on a trip to the Bad Lands in northwest Nebraska and South Dakota in the summer of 1892, collections of rattlesnakes were made. Being much interested in the recent articles on "Feigned Death in Snakes," I have the following statement to make: Whenever a freshly captured rattlesnake was introduced in the box with the former captures it usually vented its rage on them by striking and biting. No ill effects whatever ensued. Also, when teased, the snakes would bite one another. We lost no rattlesnakes whatever on the trip. We often teased the snakes before capture, and in not one instance did they show any tendency to feign death. H. H. EVERETT.

Lincoln, Neb., Dec. 27, 1893.

THE LEAST BITTERN.

LAST summer a wounded bittern, the smallest of them all, *Botaurus exilis*, came into the grounds of the New York State Fishery Commission, at this place, and as its wing was hanging down one of my men caught it and amputated the wing. It remained and fished in a swampy bit of land where the minnows are plenty, in a pool fed by tide water, and promises to winter there. Its habit of remaining motionless when I approach it slowly and in plain sight is interesting, perched on a stick, or standing in the mud with its neck drawn up close and bill pointed upward. I can go within two

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feet of it and walk all around it, and the bird will not betray a sign of life, even by winking. This I do several times a week, but, if I come on it suddenly, over the bank, it will utter a cry and flop into the water and wade or swim off. I am getting fond of seeing it simulate an inanimate thing.

FRED MATHER.

Cold Spring Harbor, N. Y.

BOOK-REVIEWS.

Handbook of Public Health and Demography. By EDWARD F. WILLOUGHBY, M.D., Lond. London and New York, Macmillan & Co. 509 p., 1893. $1.50.

THOUGH appearing for the first time under the present title, this is, in fact, a third edition, greatly enlarged and improved, of the "Principles of Hygiene," published in London, 1884 and 1888. To this latest edition several important chapters have been added, as, for instance, those on "Vital Statistics," "Sewage Disposal," "Unhealthy Trades," and "Sanitary Law," while some other matter entirely irrelevant to the subject in hand has been omitted. The author, as stated in his preface, has endeavored throughout so to combine scientific accuracy with the popular treatment of personal health and social problems as to render the work a clear and comprehensive manual of the principles and practice of public health, equally adapted to the purposes of the medical man, the student, the teacher and the general reader. Hygiene is treated under the general heads of "Health of the Man," "Health of the House," "Health of the City" and "Health of the People," with sub-divisions into sections on "Dietetics," "Clothing," "Exercise," "Air, Warmth and Light," "General Sanitary Arrangements," "Water Supply," "School Hygiene," "Preventable Diseases," etc. The remaining chapters include an admirable treatise on "Demography," in which many common errors, statistical and otherwise, are exposed; a chapter on "Meteorology," another on "Sanitary Law," and an appendix of tables, etc. These various subjects are discussed so thoroughly and are so comprehensive that we are provided with a most excellent book of reference in all matters pertaining to hygiene.

Particularly noteworthy are the sections on "Dietetics" and those dealing with "House Drainage and Sanitation," and also that which discusses the neglected question of "School Hygiene." We say neglected, for even in the face of modern enlightenment on these subjects many, if not most, of our school buildings continue on the same general lines of the last generation, remodelled only so far as to gain a greater seating capacity. We do not refer to the "sanitary arrangements" of the plumber; the school building is always a favorite place for costly experiments in that direction, but rather to the heating, ventilating, school desks and seats, etc. One defect which is probably the last thought of in school building, and yet the surest in its evil effects, is that of school lighting, and in treating this all-important section the author has given us the benefit of such authorities as Professors Cohn and Förster, of Breslau, the eminent oculists. How important this subject is at once comes home to one when we remember the alarming increase of weak eyes among school children, the headaches, and the so often repeated complaint that "It hurts my eyes to look at the black-board." The chapter on "Dietetics" embraces a discussion of food stuffs, the classification and uses of food, the relative values of the common foods, their proper preparation and the adulterations which they may contain. It will be seen that the subject matter is most general, and embraces practically all that is of moment in sanitary matters; while, moreover, the arrangement and treatment are most admirably suited for convenient reference. Methods of hygienic chemical analysis are given in so far as is deemed necessary, and these sections will prove particularly valuable as an aid to the interpretation of results obtained through an expert chemist.

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Museum of Hamline University desires to exchange Marine Shells, preserved alcoholic material of marine zoology, or microscopic slides for zoological specimens from southern and western United States, especially for rodents in the flesh. Correspondence solicited. Address Henry L. Osborn, Biological Laboratory of Hamline University, St. Paul, Minnesota.

For Sale.—Small collection of fine first-class sets of birds' eggs; single breech-loading shotgun, gold-filled hunting-case watch and telescope. Write for list of eggs and particulars. B. S. Bowdish, Phelps, N. Y.

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CONTENTS.

Some New Jersey Eskers. G. E. Culver..... 15
Coloration of the Ruffed Grouse. J. H. Bowles. 16
Volcanic Rocks in the Keewatin of Minnesota. Ulysses Sherman Grant..... 17
Current Notes on Anthropology.—XXXVII. Edited by D. G. Brinton..... 18
Secret Language of Children. Oscar Chrisman. 18
Werner's Real Contribution to Geology. J. B. Woodworth 19
Habits of the Purple Finch—*Corpodacus Purpureus*, Gray. M. W. Vandenburg..... 20
Jews and Hittites. Felix von Lyschan..... 21
The Departments of Geography. Hugh Robert Mill..... 22
The Age of the Iron Ores of East Texas. William Kennedy..... 22
Sorghum Sugar. T. Berry Smith 25

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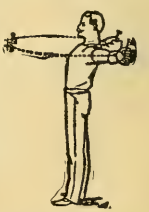

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SOME NEW JERSEY ESKERS.

BY G. E. CULVER, MADISON, WIS.

THE eskers here noted are found in the northeastern part of the State a little east of the valley of the Ramapo. The district embraced is about four miles wide and eight miles long. The series of deposits lies in a gentle depression extending from the point where the Ramapo enters the State, south to the neighborhood of Ramsey's, where it broadens somewhat and connects with other similar valleys, after which all turn southwestward and are noted as far as Wyckoff and Camp Gaw on the Susquehanna Railroad.

Besides the eskers proper there are here gravel sheets and bodies of various shapes, all more or less directly connected with the eskers.

The disposition of all these deposits is to keep well down on the sides or in the bottom of the valleys. Nevertheless, their elevation is not constant, and the eskers cross, at different points, small valleys and low ridges to some extent.

Of the eskers proper the three best are the Ramsey's, the Allendale and an esker beginning about a mile west of Ramsey's and running parallel with the Ramsey's esker.

These, with their branches, constitute a group not unlike a river system.

The Ramsey's esker is the central one of the group. It is also the longest and the best type of an esker. It begins north of the State line in the vicinity of Suffern, N. Y., and extends south to the neighborhood of Mahwah, where it is interrupted, and in its course are several flat-topped, delta-like deposits of precisely similar material, *i. e.*, loose textured sand and gravel. These deposits extend south of Mahwah about a mile and a half, at which point they cease, and the esker again becomes distinct and prominent. It crosses the Erie Railroad in the northern edge of the village of Ramsey's, then runs southwest for about a mile and a half, where it is again interrupted and is probably represented by various shorter branches or pieces of eskers extending nearly to Wyckoff.

This esker has its best development about a half mile southwest of Ramsey's, where it crosses about half a mile of low ground. It stands up clean and clear as a sharp ridge of gravel about twenty-five feet high and one to two rods wide on top. Its sides are as steep as gravel and sand will lie. Its course is sinuous, like that of a stream.

Besides the wide gaps which occur in nearly all of these eskers there are several narrow gaps, through some of which small streams now flow. In the case of the wide gaps the esker usually thins perceptibly, if not greatly, before disappearance, but where the narrow gaps are found the esker terminates abruptly on one side of the valley and begins as abruptly on the other. The resemblance to a railroad embankment where a stream is to be crossed by a high bridge is marked.

Present appearances indicate not that the stream has cut the gap in such cases, but rather that the gap was either never filled or else the material was removed while the ice was still near.

None of the eskers nor the associated deposits seem to have suffered much, if any, post-glacial erosion.

About a mile and a half southwest of Ramsey's a deposit is found which seems to have been made by the union of three small eskers which come in here.[1] It is an oval, rather flat-topped body of sand and gravel, covering, perhaps, an acre to the depth of twelve or fifteen feet. Two branches, apparently from the Ramsey's esker, come in from the north, another comes in or goes out from the southwest, while a fourth leads out to the south. The three first mentioned come from higher ground to the junction. The one going south descends from the junction, following the course of a small stream for about a mile, where it enters another and larger junction deposit, through which it connects with the Allendale esker. This second junction deposit is about a quarter of a mile long by half as wide, and rises forty feet above the eskers connecting with it.

It is steep-faced on the sides facing the lower ground, but seems to lap onto the higher ground on the northwest smoothly as though it were wedge-shaped. The thick end of the wedge lies toward the low ground, and the surface is quite level.

In all particulars save one this deposit is like the bodies of sand and gravel lying in the course of the Ramsey's esker south of Mahwah. Some of those are fifty feet deep, flat-topped, steep-faced on the lower side and shade into the higher ground gradually. But they are not directly connected with an esker. The analogy, therefore, is not complete.

In the esker west of the Ramsey's esker occurs a feature which is perhaps suggestive in this connection.

This esker, after running as a sharp, well-defined ridge for more than a mile, in which distance it climbs about forty feet, turns sharply to the right, descends about thirty feet in less than half a mile, makes a broader turn into its former course and then gradually expands to fifteen or twenty times its former width, with a corresponding increase in the quantity of material deposited. It then narrows slightly and terminates abruptly, or rather is interrupted by one of the narrow gaps previously mentioned.

Beyond this gap it first widens and then narrows to to its original width—about a rod on top.

Here are three closely analogous types of deposits intimately associated with eskers. In topographic features they are practically the same, in material

[1] So far as I know this feature has not been before noted in connection with eskers, and hence no name to designate it has been suggested. In the absence of a distinctive name I have simply called them junction deposits.

and texture precisely so. All lie in the path of eskers. But they are differently connected with the eskers. The deposits south of Mahwah simply lie in the course of the Ramsey's esker, but are separated completely from it.

The junction deposits are connected directly with the eskers, but show decided differences of level as compared with the associated eskers. The Allendale junction deposit stands forty feet higher than either of the two main esker branches which unite in it.

In the third type we have the esker itself gradually widening out into a broad thick mass without marked change of level. In this case we have also the subsequent narrowing of the deposit to its original esker proportions.

If the first or Mahwah type alone were considered, perhaps the most natural inference regarding its genesis would be that a rapid stream had here debouched into the still water and there built the delta-like deposits.

Yet even in this group, which includes some half dozen of these gravel bodies, are several that can hardly be so accounted for, and in each of the other types it is clear that the material was brought to its present position by ice-walled streams.

In the case of the junction deposits it seems to this writer that a satisfactory explanation of their origin may be found by supposing that these deposits mark the points at which one or more crevasses in the ice intersected eskers. The radiating gravel ridges now mark the position of the intersecting crevasses.

That all these gravel deposits were made near the ice front is probable from the fact that a little farther south all the gravel is spread out in sheets. It is therefore reasonable to suppose that there were openings in the ice-front, bay-like in character, and that there were other openings within the ice border less directly connected with the open water along the ice border.[2]

The suggestion is offered, therefore, that these variously disposed bodies of esker material mark the places where openings of greater or less size had been formed by various agencies not far from the ice front and in the path of the ice rivers.

The streams would pour their contents into these openings. The water would escape, but the sand and gravel would accumulate in the openings until it either filled them completely or until new avenues were opened for its onward movement.

On the final melting of the ice the deposits of sand and gravel would be left resting on the till beneath, whether the streams which brought the material were subglacial or englacial.

COLORATION OF THE RUFFED GROUSE.

BY J. H. BOWLES, PONKAPOG, MASS.

ALTHOUGH much has been written upon the two plumages in which our screech owl (*Megascops asio*) has been found, comparatively little has been *printed* concerning the variety of colors worn by the ruffed grouse (*Bonasa umbellus*), which seems surprising, as it is a favorite game bird. My experience has been with the birds of eastern New England (from Massachusetts northward), but I am inclined to think that the conditions are the same in other portions, for like the screech owl there is a red and a gray plumage.

Perhaps I can best explain my meaning by selecting three birds from a bag taken in this vicinity, as they show to perfection the three different phases seen in this species, viz.: gray, brown or red, and intermediate.

[2]It is not meant here to assert that still water of any depth was to be found along the ice front at the time mentioned, although such might have been the case.

The breast feathers show comparatively little difference, but when the backs of the birds are compared the contrast is at once apparent. Taking the one in the gray plumage, which is the type found most commonly in Maine and the other northern parts, the fan of long tail feathers is of a decided grayish cast, the back, upper and lower tail coverts being of the same shade. (The tail coverts and back vary in intensity to a greater or less extent in individuals.) The ruffs are black throughout, with a strong tinge of iridescent green.

The next to be considered is the bird in the brown or red plumage, which is, from what I can learn, the phase more commonly found in the southern portions. Its fan is of a decided rufous tint, appearing in no way like that of the northern bird except for proportions and the transverse black bands. (These bands are almost always black, having a decided tinge of rufous in but *very* few cases.) The tail coverts and upper parts are also of a reddish tint, the ruffs being a strong brownish-red, tipped with dark brown, and tinged with iridescent brown. All things considered, the northern and the southern bird, when laid side by side, would hardly be taken for the same species.

Upon consideration, I am convinced that it would be impossible to show satisfactorily the third phase in one specimen. The upper portions of what I should consider the typical intermediate bird are what might be termed "pepper and salt," for the fan (always excepting the transverse black bands) is of a mixed red and gray color, the tail coverts and back being a medley of gray, dark brown and red. The ruffs may be either black or brown, for I have seen about an equal number of each. However, there is a wonderful variation, for I have taken birds having brown ruffs, back and tail coverts, yet with an almost entirely gray tail. This phase, like the preceding, is more commonly found southward.

The intermediate stage may, I think, be due to the inter-breeding of northern and southern birds, which meet at about the latitude of Boston, for they are found commonly on or near that line. As the ruffed grouse is greatly given to migrating, this theory seems possible. Another curious fact has become more apparent to me year by year, namely, that in the vicinity of Boston the birds in the red or intermediate phase are taking the place of those in the gray, until this season I have taken an average of three red or intermediate birds to one gray one, whereas in former seasons it was exactly the reverse.

In regard to nidification, I have not been fortunate enough to approach sufficiently near the birds on more than three nests to distinguish the color of their ruffs. Much to my satisfaction, however, one of these was red with brown ruffs, the other two being gray with black ruffs. Curiously enough, in both sets of the black-ruffed birds the eggs were light colored with very faint markings, while those of the red bird were larger with a darker ground color, most of them being thickly sprinkled with large, well-defined spots of reddish-brown. Of course this may have been purely accidental.

In conclusion I will deviate from the subject by giving my opinion that if the bounties were removed from owls and hawks, and put upon skunks, foxes and other vermin, our supply of game and song birds would be greatly increased; nor do I think that the farmer would suffer, in the aggregate, by such a proceeding. My reason for so thinking is the number of nests (including those of the ruffed grouse and oven bird) of eggs and young which I have found destroyed by these pests, not to speak of the number of birds killed after reaching maturity, which is comparatively small.

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Attention is called to the "Wants" column. It is invaluable to those who use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

VOLCANIC ROCKS IN THE KEEWATIN OF MINNESOTA.[1]

BY ULYSSES SHERMAN GRANT, MINNEAPOLIS, MINN.

THAT the Keewatin rocks northwest of Lake Superior are to a considerable extent composed of volcanic (effusive) material has been stated already by G. M. Dawson,[2] A. C. Lawson[3] and N. H. Winchell[4]. Although the material of much of the Keewatin in Minnesota has been assumed to be volcanic tuff and finely divided, water-deposited ash, the actual number of places where the rocks have been shown to be composed of such volcanic matter is very small. M. E. Wadsworth has described a few sections of fragmental volcanic rocks,—porodites,[5]— and N. H. Winchell has given an account of an agglomerate from Ely.[6] Aside from these the writer knows of no descriptions of rocks from the Keewatin of Minnesota that are clearly shown to be of volcanic origin.

In the neighborhood of Kekequabic Lake, in the northern part of Lake County, a rock has been found which proves to be a volcanic fragmental. It is in the midst of thick Keewatin strata,—argillites, graywackes, conglomerates, green schists, etc.,—which form the eastern extension of the Vermilion iron range. The rock under discussion varies much in general appearance, but is usually of a greenish color and very compact and tough. The groundmass is aphanitic and in it are numerous, lighter blotches and changes of color, between the blotches, and sometimes in them are black crystals of hornblende; pyrite is also quite common. In certain places rounded and subangular pieces of quartz and argillite are embraced in the rock. Parallel color-bandings resembling sedimentary laminæ also occur, occasionally quite abundantly, but usually the rock shows no structural planes of any kind, nor any schistose or slaty cleavage. In thin sections the fragmental character of the rock is easily discernible. The fragments are usually angular, and their original nature is not always evident, owing to alteration and to the development of secondary minerals, but it seems that a porphyrite forms most of these fragments. The groundmass of the rock is largely fibrous hornblende. There are also areas of secondary hornblende, both in the groundmass and in the fragments, filling in old crystal outlines; what crystals originally filled these places is not clear, but it is probable that they were pyroxene phenocrysts. The rock thus appears to be a volcanic tuff completely solidified and more or less altered.

Closely associated with this volcanic tuff, and grading into it, are some peculiar green schists, which, like the groundmass of the former, are made up almost entirely of hornblende. That these schists are composed of water-deposited material is clearly shown by numerous laminæ, frequently running at an angle with the schistose cleavage, and in places by rounded quartz pebbles arranged in parallel lines. Under the microscope a section from these schists is seen to consist of closely crowded, green hornblende crystals embedded in a fine, fibrous groundmass also made up of hornblende. The crystals are, in short, stout prisms, averaging about a quarter of a millimetre in length. They are commonly, not completely idiomorphic; the prismatic planes are very generally quite distinct, but the terminal faces are not so often well developed. The ends of the crystals often show fringes or fibrous prolongations running out into the groundmass. At times these fringes are sharply marked off from the crystal proper, being of a lighter color, but the fringe on each crystal is optically continuous with it. These fringes closely resemble the secondary enlargements of hornblende grains and crystals described by C. R. Van Hise[7] and are probably of a similar nature. As to just what was the nature of the sediment which formed these green schists, it is impossible to decide, but there are several reasons for regarding it as chiefly finely divided, water deposited, volcanic ash now entirely recrystallized.

In the immediate neighborhood of the tuff and green schists is a small area of a fine-grained, purple, porphyritic rock, which proves to be a hornblende porphyrite. This has distinct, elongated phenocrysts of brownish hornblende imbedded in a completely crystalline groundmass of interlacing feldspar laths; in places this groundmass becomes almost granular in structure. From its known relations to the surrounding rocks, the completeness of its crystallization and the absence of structures common to effusive rocks, this porphyrite appears to have never reached the surface, although such a degree of crystallization might possibly have been attained in the centre of a very thick flow.

It seems probable, then, that in Keewatin (Lower Huronian, as that term is used by the United States Geological Survey) time a volcano existed in this locality, that it furnished the deposits of tuff and ash described above, that its lava was of about the composition of hornblende porphyrite, and that the present known mass of porphyrite represents a part of the igneous magma which solidified below the surface.

A more complete account of these volcanic rocks and the surrounding rocks, especially of an interesting augite soda-granite, concerning which a preliminary note has already been published,[8] will appear in the forthcoming twenty-first annual report of the Geological and Natural History Survey of Minnesota.

[1] Published by permission of the State Geologist of Minnesota.
[2] British N. A. Boundary Commission, 1875.
[3] Geol. Surv. o Canada, vol. iii, pt. i, 1888.
[4] Geol. and Nat. Hist. Surv. of Minn., 15th Ann. Rept., 1887; 16th Ann. Rept., 1888; Bull. No. 6, 1891.
[5] Ibid.; Bull. No. 2, 1887.
[6] Amer. Geol., vol. ix, pp. 359-368, June, 1892.
[7] Amer. Jour. Sci., III, vol. xxx, pp. 231-235, Sept, 1885.
[8] Amer. Geol., vol. xi, pp. 383-388, June, 1893.

—In view of the present interest in German politics, social and political life, and educational affairs, the new work, "Germany and the Germans," by William Harbutt Dawson, is timely. Mr. Dawson, who is well known as the author of "German Socialism and Ferdinand Lassalle," and "Prince Bismarck and State Socialism," has made a close study of German life and institutions at the present day, and the results of his observations are set forth in an interesting manner. "Germany and the Germans" will be published immediately by D. Appleton & Co.

CURRENT NOTES ON ANTHROPOLOGY.—XXXVII.

(*Edited by D. G. Brinton, M. D., LL.D., D.Sc.*)

Art in Anthropology.

The student of anthropology must be delighted to see how it is enriching learning in all directions by supplying the material from which can be derived the laws for the development and acquisition of knowledge—that which the Germans call *Erkenntnisslehre*.

In few directions has there been greater need of this than in the domain of art. We have had abundance of histories of art, and some efforts toward systems of the philosophy of art; but a science of art, something which would show us the laws which prevail in, and govern, the apparently so irresponsible and capricious development of art,—this has been wanting.

An admirable effort to supply this deficiency has recently been published in Leipzig under the title, "The Beginnings of Art" (*Die Anfänge der Kunst*), by Dr. Ernst Grosse. It is a manageable volume of 300 pages, in an attractive style, enriched by a sufficient number of illustrations. The author understands art in its broad sense, including music, poetry, painting, sculpture, ornamental design, dancing and cosmetics. In all these directions he examines the conditions and influence of primitive art, and its social and individual significance The conclusion which he reaches is one most significant and pregnant with suggestion, to wit, that certain definite and absolute relations exist between given forms of general culture and the growth of the arts which accompany them; though the hidden psychical forces which underlie the laws of these relations may and generally do remain obscure or unseen, the fact of the relation cannot be denied.

The volume is worth a careful study.

The Ancient Kingdom of the Himyarites.

In the early Greek and Roman geographers southern Arabia is referred to as "Arabia Felix" and described as "a fortunate land, odorous with spices, and abounding in gold and ivory and all manner of precious stones." When its majestic Queen visited King Solomon "no such spices as the Queen of Sheba brought had been known in Jerusalem."

How does it happen that that land is now, and for a thousand years has been, a barren waste? That its ancient palaces are choked with sand? Its gardens and spice groves given way to the arid desert? Some fatal change in climatic conditions, a destructive increase in exsiccation, may be the cause. Only in the last few years, owing to the researches of Glaser, and later of J. T. Bent, are we in some measure able to restore the faint outlines of that wondrous kingdom, which for nearly a thousand years was the medium through which the gold of south Africa, the frankincense of Abyssinia, the diamonds and spices of India, passed to the wealthy nobles of Egypt, the dealers of Tyre and Sidon, and the peoples of the Mediterranean.

The great Zimbabwe ruins in Mashona land, the venerable temples near Aksum in Abyssinia show by their plans, and the latter by inscriptions as early as 800 B. C., that they were colonies of the Himyarites.

What a mighty influence this trade exerted on the ethnography of east Africa and India and all the intermediate regions, we can readily imagine. It is enough to explain the strange discovery of M. Dieulafoy, at Susiana, that that ancient realm had a large population of African negroes. We need no other theory for their presence than this trade of the early Arab merchants, who brought then, as they do to-day, their dhows loaded with human freight from the teeming shores of the dark continent, to dispose of them among the whites of the Asiatic main.

Human Relics in the San Isidro Gravels.

In the Museum of the University of Pennsylvania is a chipped stone implement which about a year ago was found in place, and extracted with the most scientific precautions, by Mr. H. C. Mercer, one of the curators of the Museum, from the gravel bed of the River Manzanares, at San Isidro, near Madrid, Spain. It is peculiarly valuable because these gravels are held to belong to the Palæolithic or oldest stone age. It was exhibited and described by Mr. Mercer before the American Association for the Advancement of Science at Madison, last August, and it is a well-marked type of a most ancient implement.

The same locality has been made the subject of an excellent paper by the Baron de Baye, in a late number of the Bulletins of the Anthropological Society of Paris. He refers quite fully to the literature of the subject, and imparts a considerable amount of new information from M. Siret, the Belgian engineer, well known for his admirable researches into the archæology of Spain. The objects belong to the "Chelleen" and "Mousterien" types of the French archæologists, which would put them back to the very beginning of human industry.

Unfortunately, the bones which have been taken from these gravels have not received careful examination, so from them we cannot define the age of the horizon. It is quite certain that these beds were not deposited by the Manzanares, but by a much larger stream running in a different direction. The physical geography of the district has undergone profound alterations since they were stratified. The station is one of the first in importance and merits a thorough investigation.

The Mocovi Language.

Students of American languages, especially of those of South America, will welcome with much satisfaction the appearance of the collection on the Mocovi, edited for the Museo de la Plata, by S. A. Lafone-Quevedo.

It is largely based on the MSS. of Father Tavolini, an Italian missionary, but is by no means confined to these. The editor begins with a learned essay on the comparative linguistics of the Chaco languages, and in his notes brings forward much other information from the writings, in part manuscript, of Barcena, Dobrizhoffer, Pelleschi, and others. From these varied sources the diligent student will find in the volume, which altogether makes up more than five hundred large quarto pages, abundant material from which to acquaint himself satisfactorily with this little-known tongue.

In this connection, it is pleasant to note that the attention to American languages is slowly on the increase. Among the "Conferences" published in 1893 by the Atheneum of Madrid, was one of 112 pages on American linguistics by Don Francisco de Fernandez y Gonzalez, which is marked by a creditable acquaintance with the literature of the subject; and in the Anales de la Universidad, of Santiago, Chili, there is a well-prepared article on "La Linguistica Americana, su Historia y su Estado Actual," by Diego Barros Arana and Rodolfo Lenz. Several works have also been announced in Germany and France, which show that the scholars in those countries are awakening to the large scientific interest which these languages have.

SECRET LANGUAGE OF CHILDREN.

BY OSCAR CHRISMAN, CLARK UNIVERSITY, WORCESTER, MASS.

Two parties having seen the article in *Science* of Dec. 1 have sent me the secret languages of their childhood.

William M. Gregg, M. D., No. 143 West Twenty-first street, New York, sends the following:

"Olafcscarlafar Crilafistelafamalafan:

"Halafavilafing olafobserlafirved alafan artafartilafecalafal ilafin *Silafialafance* olafon 'Selafecalafrete Lanafangalafage olafove Chilafreldelafrend,' ilafi ilafinclolafose thilafis notafote tulafu alafask ilafif oolafue halafave elafeverlafer selafene elefennelafeny lilafike ilafit."

The translation of the foregoing is:

"Oscar Chrisman:

"Having observed an article in *Science* on 'Secret Language of Children,' I inclose this note to ask if you have ever seen anything like it."

Dr. Gregg states that he has not used the language, except to himself, in over fifty years. He thinks it must have originated in his family, or in the neighborhood, at Elmira, N. Y., where he lived when a child. He and his younger brother became most proficient in the use of this language, although all the members of the family understood it, being used by them for ten or twelve years. The spelling of the words is quite arbitrary, the principal object being to disguise them as much as possible. Sometimes words were contracted, as in *yalafas*, for *yes, fas* was simply used, leaving off the *yala*. When the language is well spoken it sounds somewhat like Hebrew.

Miss Martha L. Sanford, No. 21 Oread Place, Worcester, Mass., furnishes the following:

"Concerning the 'secret language,' Hog Latin, or rather the particular form of the dialect I knew, perhaps some concrete examples may be best, for instance: *Cagry yougry uggry stagry Hogry Lagry?* meaning, Can you understand Hog Latin?

"*Igry wegry dowgry towgry thigry morgry.* I went down town this morning.

"*Itgry igry raigry horgry nowgry.* It is raining hard now.

"*Wegry shagry hagry agry greegry Chrigrymagry, Mrigry Praggry sagry.* We shall have a green Christmas, Mrs. Pratt says.

"In order to represent the sounds I ought really to use the diacritical marks, since in writing the language (which I think I never did before, since it was, so far as I know, always a *spoken* means of communication) the same combination of letters may represent more than one word; for instance, *wegry* may mean *went, we, well, wet*, and so on. Of course, the sentences we composed were usually simple, and if the hearer failed to comprehend a word, it could be made plainer by simply adding the syllable *gry* to the word, as, *wetgry, wentgry*, etc."

It is pleasantly surprising that these two parties should each have furnished me something in secret languages which I had not met with before in my study.

Dr. Gregg gives the following numbering connected with his "gibberish," as he calls it:

"1, unzol or unica; 2, zulzol or ureica; 3, ziczol or irick; 4, zan or an; 5, filize; 6, falize; 7, niczol-tan or nicholastan; 8, minzol; 9, tinzol; 10, hoppzolan or hip.

"The above are the numbers which were used in connection with the gibberish I have sent you. It may possibly be derived from some nursery rhyme, as you will observe that it has a sort of sing-song about it."

Miss Sanford sends this small scrap of a cipher alphabet. I do sincerely hope she may get the whole of it, as, if I recall correctly, otherwise than in her note I have not met the least intimation of any cipher being used, and, also, this so well shows the wonderful ingenuity of children:

"With two or three intimates I arranged a cipher alphabet, using such symbols as ∞, ɑ, for letters, and I think I have, packed away in California, some scraps of our correspondence, but unfortunately they are at present unobtainable."

I wish to make a collection of the secret languages of children, so I have asked the editor of *Science* to be kind enough to insert the following:

1. Please look back into memory and see if you have traces left of secret languages.
2. How old were you when you used such? How long since?
3. In what city, town, or district were you living at the time you used these languages?
4. What did you call it?
5. Was it written, spoken or both?
6. Did you use special characters to write it? If so, give them.
7. Was the language pretty generally used or was it known to only a few?
8. Did the language originate with you or your schoolmates? If not, trace it as far as you can to its origin.
9. What is the special catch in the language; is it a syllable, a letter, an alphabet, or something else? Give it.
10. Write a sentence of not more than *twenty-five* words in your secret language, then immediately following give the words in the regular English.
11. If other points come into mind not touched upon by the queries above, give them.
12. If you can learn of a secret language being used now by children it will be of the very greatest interest and benefit to gather it up.
13. In writing down the secret language be careful to make your letters very plain, and go over it again and again to be sure that your words are spelled as you want them.
14. You may be aided in gathering and writing your language by reading my article "Secret Language of Children," in *Science* for Dec. 1, 1893.

If the readers of this will be kind enough to collect such material as they may find in memory or from notes or from children and send to me, I shall be truly thankful, as I wish to continue my studies on the secret language of children, and your aid will be of great service

WERNER'S REAL CONTRIBUTION TO GEOLOGY.

BY J. B. WOODWORTH, CAMBRIDGE, MASS.

Prof. G. H. Williams did a service to his generation by recalling to mind, at the Boston meeting of the Geological Society of America, the contributions to North American geology made by Johann David Schoepff. It would be a very useful thing for the student of philosophical geology to have at hand a thesaurus of first authors or originators, arranged somewhat after the plan of theories of mountain building compiled by the late Alexander Winchell in his "World Life." A work of this kind would place credit where it belonged, and would, if carried out on a comprehensive plan akin to Gilbert's "Classification of Geological Phenomena," present the state of geological theory in the different departments of the science. The case of Abraham Gottlob Werner illustrates the need of such a handbook.

Werner was born Sep. 25, 1750, and died June 30, 1817. He is justly celebrated for his influence upon geology, but the prominence which the erroneous theory he propounded gave him in the controversy between the Vulcanists and Neptunists has led, as Professor John Phillips has stated, to overlooking his real contribution to geology. "We must forget his theory," writes Phillips in his sketch of the progress of the science, "and view only the data which he collected for its foundation." Sir Charles Lyell, in the admirable résumé of the history of geology, which he gives in his "Principles," does not credit Werner with the development of the principles of studying rock structure, on which the success of the field geologist depends. Phi

lips gives two principles as the basis of Werner's system:

1. "When two veins cross, and one of them cuts through the other, the one which is divided is the more ancient."

2. "In effect, among superimposed stratified rocks, the lowest was deposited first and is the oldest."

Lehman, it seems, worked out these principles in part before Werner, but he fell short of his countryman in the extent of their application and significance.

By the first of Werner's laws, we determine not only the relative time of occurrence of veins and dykes, but also that of faults, joints, brecciation and other minutiæ in modern petrographical investigations with the microscope. In the same category of contact phenomena might also be placed unconformities, the importance and use of which have only within a few years been fully elaborated by the geologists of the Lake Superior district.

The second of Werner's generalizations is to stratigraphic geology what the first is to the study of igneous rocks and secondary structures. How these, to us seemingly obvious, laws are used in modern geological instruction and field investigation is seen by Professor Davis's paper on "Instruction in Geological Investigation" (in *Am. Nat.*, xxi., 1887, pp. 810-825). One essential advance is in recognizing what Hutton insisted on, the intrusive origin of the igneous rocks, and in interpreting unconformities, but our method of diagnosing a field of outcrops or the structure of a mine is that which Werner pursued with his classes a century ago.

HABITS OF THE PURPLE FINCH — *CORPODACUS PURPUREUS*, GRAY.

BY M. W. VANDENBURG, FORT EDWARD, N. Y.

THE pleasant articles contributed to *Science* by Dr. Morris Gibbs, on "Birds and Bird Life," have reawakened observations often made by me on the habits of this spirited little songster. Some of these habits are, in so far as I know, unique; others are rarely found in other species, while still others are common to many species.

In its arrival from the south the purple finch often divides honors with the song sparrow, and pours forth from the top of some tall naked maple or elm such a voluble, rattling, exuberant song it seems as if he must needs sing or burst. This, too, while fields are white and winds blowing keen. In ten days or so, the females appear in twos, threes or fours. In the little flocks, if so few as six to ten can be called a flock, every one goes as he or she pleases, though they always keep in sight of each other, or in hearing of the sharp "chick" call-note.

Soon as the days grow mild, and snow leaves the fields, mating begins; and now comes the strange part of the story. The females sing as well as the males, and, what is more, the full round of the "set song." That is, the purple finch has a full, regular song of a certain number of notes (words), always repeated in the same order, and with very rare variations from this order. It is repeated very rapidly in a loud, high-pitched key, and ends very abruptly in the early spring song of the male, and always so in the song of the female. In the later spring song of the male, there follows the loud song, a very soft tremulo strain containing, it always seemed to me, a mimicry of the notes of other birds, among which one may detect one or two words from the pee-wee. This *sotto voce* song finally dies out as if he had forgotten the last notes, and often ends with a little whistle.

The female never aspires to this part of the song. Her song is a signal for all the males to assemble, and then the rapid fighting begins. The female downs fiercely every male who dares approach her, but is very lenient towards her own sex. So vicious and vigorous are her attacks that the male usually gives her a wide berth and keeps his eye quite as much on the avenue of escape as on her comely figure. This is no mistake of mine. It is not the song of an immature male.

And this is why I know I am correct. For several years I had a pair of these birds in a cage, where they were reared from the time they left the nest. On the approach of spring, say about the last of February or first week in March, the birds became very restless. They both began to sing; they grew very quarrelsome and constantly indulged in the fiercest brawls. Wilson says: "They appear to be of a tyrannical and domineering disposition," and not an hour passed in the day that did not demonstrate the correctness of this observation.

From being perfectly peaceful and considerate of each other, they grew so quarrelsome, so persistently pugnaceous, that they disturbed the whole household, and often the cage had to be covered over to lessen the bickering. In these first days of war the female was always victor, and she was wholly merciless. Later on her courage gradually failed, and by the end of a month or six weeks they ceased to fight, the male having won the day. He would "boss the household" for a week or two, with a pretty firm hand of authority, but not until many a well-fought field had been lost and won for days and days in succession.

They could never be pursuaded to build a nest. The female would lay from three to four eggs in the cage bottom. For one or two seasons a second laying succeeded, but this was not usual.

In the wild state the male never approaches the nest. He alights on a tree six to ten rods away and rapidly sings his full, *loud* song once or twice. The female answers him with a low call-note, leaves the nest and he feeds her from his "crop" in the same manner as the yellow-bird feeds its young. This done, he takes a hurried leave, and she returns to the eggs.

When the young first hatch this process continues, and the mother feeds them from her own crop, after being supplied by the male. Later on the male seems to forget his family altogether, or to feed the mother rarely and at a greater distance from the nest.

In the end, the whole care of the family seems to devolve on the female, and the ungracious sire never recognizes in any way his legitimate offspring.

I do not know whether the female sings previous to the second nesting or not, but would think it probable that such was the case for a few days at least.

I have met with unmated females singing as late as May or the first of June. The mated female, who no longer tolerates such giddiness and waywardness in a sister, pursues the singer with all the vim and viciousness she can command.

The male, too, not infrequently comes in for a bluff rebuke, if he is not discreet in his attentions to the coy spinster.

Such have been my observations of the purple finch, extending over a period of thirty years. They are in the main correct, as it seems to me, for they have received confirmations during every year of that time.

JEWS AND HITTITES.

BY FELIX VON LYSCHAN, BERLIN, GERMANY.

Our modern Jews are generally believed to represent a pure and typical branch of the Semitic race, and even authors, who are well aware that we find mixed blood on the remotest and apparently most isolated islands of the Pacific, seem inclined to admit an exception for the Jews. It seems of interest, therefore, to study Jewish types, not only as to their general impression, but by measuring their heads and skulls and comparing them with other representatives of Semitic nations. The result has been a most striking one.

As Semitic races, or as others prefer to say, as branches of the Semitic race, we generally consider the Babylonians, the Assyrians, the Hebrews, the South Arabian Sabæans, the Phenicians, the Aramæans, the Abyssinians and the Bedouins of northern Arabia and of Mesopotamia. Now, the anatomical characteristics of these eight people, which all are, or have been, speaking typical Semitic languages, are most divergent; only the Bedouins, whose language also is remarkable for its very archaic character, seem to form a homogeneous unity, with little mixture of strange elements; their modern physique is the same as we see it represented in the earliest Egyptian monuments, and also our earliest skulls of Phenicians seem identical with old and modern Bedouin skulls, so that we must consider the modern Bedouins as pure descendants of the old Semitic race. They have long, narrow heads, dark complexion, and a short, small and straight nose, which is in every respect the direct counterpart of what we are accustomed to call a "typical Jewish nose." But of our modern Jews nearly 50 per cent are brachycephalic, 11 per cent have fair complexion, and not more than 5 per cent correspond to what we have learned to be the real old Semitic type. Still more striking proportions we find, if we go to northern Syria, the land of the old Aramæans; there nearly all the heads are brachycephalic, with indices near to 90; and these same brachycephalic elements we find everywhere in western Asia; we find them, more or less prominent, even with the modern Greeks, Armenians and Turks of Asia Minor, and specially the Armenians are most remarkable for the nearly complete uniformity of their types, for their dark complexion, for their extreme brachycephalism and for their large and hooked "Jewish" nose.

Such and other investigations lead us to the conviction that Syria and Asia Minor were in early times inhabited by a homogeneous and extreme brachycephalic race, of which modern Armenians are the nearly pure descendants, and which we find more or less mixed with strange elements, in many of the other races that now inhabit western Asia. This old brachycephalci race, which from its beginning was utterly distinct from any Semitic tribe and was in physical view the very counterpart of the Semites, can only be identified with the Hittites—the same Hittites mentioned as a Syrian tribe in the Bible, which had been a strong and formidable enemy to Ramses II., and were finally conquered by Assyrian Kings in long wars and fights, beginning earlier than the times of Assurnassirpal and ending probably only in those of Asarhaddon, as we read in the Assyrian annals from the ninth century to the seventh century, B. C.

Recent excavations, made for the Prussian government in *Sendjirli,* the old Sammâl, known in Assyrian texts as a Hittite residence in northern Syria, have brought to light a large series of old Hittite sculptures; the Armenian character of the men represented on the walls and in the royal palaces of this old town is most striking, and we cannot err if we consider the inhabitants of Sammâl as the direct ancestors of the modern Armenians, which still inhabit the neighborhood of the place, ill-treated in our times by Turks and Kourds and without any knowledge of their glorious history in ancient and mediæval times.

Hittite sculptures are often found connected with a very curious, heavy and bulky looking sort of hieroglyphic inscriptions, which are not yet finally deciphered, but are now getting more and more familiar to us, thanks to the investigations of A. H. Sayce, Peiser and Peter Jensen. We have no reason to doubt that these hieroglyphs were the only sort of writing known to the Hittites in early times. Now it is a curious fact that two inscriptions were found, written by native Kings, the one in the ninth, the other in the eighth century, B. C., both in good old Semitic alphabetical characters, resembling closely the famous inscription of Mesa, King of Moab, and in a language that might be called proto-Aramæan or proto-Hebrew, but which is anyhow old Semitic, and can well be compared with the language of some parts of the Bible. So the inscriptions I found in Sammâl[1] show that already in the ninth century, B.C., Semitic influence was great in northern Syria, and we can now easily understand how Semitic writing and language soon became dominant among people of western Asia that were originally without a drop of Semitic blood; and then we understand also why most of our modern Jews have the Armenian type and not the Semitic—they are the descendants of an "Armenoïd" population that had only accepted Semitic writing and language in about 1000 B. C.

This is a similar process to what we know for Asia Minor, where millions of the native population were by force converted to the Islâm, and, having accepted also the language of their Turkish conquerors, are now generally taken as real Turks, though their blood is nearly free from Turkish influence and though they can well be considered as the true and pure descendants of the old natives of their country.

But one thing still remains to explain in the habitus of the modern Jews; it is the fact of 11 per cent of Jewish individuals with fair complexion and light eyes. All the various theories of recent mixture with Germanic elements would never sufficiently explain this curious fact; we are forced to look out for an *old* origin of the fair complexion of more than one-tenth of modern Jews, and we find it in the intercourse of the old native Syrians with the *Amorites*, the tall "sons of Enak" of the Bible, who were fair, with blue eyes, as old Egyptian painted monuments show us. We are not quite sure as to the real home of these fair Amorites, but they were probably a branch of the same fair race that once inhabited also the northwest coast of Africa, which has left there the megalithic monuments and is most certainly to be identified with the *Tamchu* of the old Egyptians, the white "people of the north" as their name explains. The Amorites would then be good fair Aryans, not in the linguistical meaning, as "Indo-Europeans," but in the strict sense of physical anthropology.

So we see in our modern Jews the descendants of three different races, the Hittites, the Aryan Amorites and the Semitic nomads, immigrated into Syria only in about the times of Abraham.

[1] Ausgrabungen in Sendschirli, Heft I. Berlin, Spemann, 1893.

THE DEPARTMENTS OF GEOGRAPHY.

BY HUGH ROBERT MILL, D. SC., LONDON.

THE sub-division of any portion of science must be largely empirical, and in accordance rather with practical convenience than with natural planes of cleavage. Thus we are accustomed to such phrases as mathematical geography, physical geography, astronomical geography, ancient geography, political geography, and the like, although it would be very difficult to piece together the fragments which pass under these names so as to make up a coherent geography. In endeavoring to sub-divide the content of geography in such a way as to bring out the natural interrelations of its parts and their logical sequence, for purposes of exhaustive study, it has occurred to me to represent the whole metaphorically by a pyramid of several courses of masonry differing in material and finish but each supported by those below and supporting those above. Thus the fundamental course would be mathematical geography, constructed of great blocks hewn from the quarries of the only absolute science, accurately squared and fitted. It includes all that has to do with exact measurement of space and time and motion, the form and dimensions of the earth, its motions and the construction of maps. Upon this base is reared the second tier, physical geography, the material for which, less homogeneous and perfect than the foregoing, comes from quarries scattered over the realms of many sciences, from chemistry, physics and the different departments of geology, from meteorology and the science of the oceans. It is concerned with all these phenomena which depend on differences of substance, structure and state, and accounts for the origin of surface features and of scenery, the interactions of lithosphere, hydrosphere and atmosphere and the effect on each of solar energy. Next in order and less regular in structure, dependent on physical geography as physical is on mathematical, I place bio-geography, wherein the influence of life is taken into account. This serves to explain how vital processes of plant and animal affect the structure of the earth, and how the lifeless features of the globe regulate the distribution of vegetation and of animals. Arising directly from this floor, but as yet only imperfectly put together, is the course of anthropo-geography, the elucidation of the action of mankind as an animal species upon the globe. The unit of consideration is mankind as a whole; the variety of races, conditions of life and density of population are the features taken into account, and the interaction between man and nature has to be studied in its widest aspects. The changes in the relation of different tribes to their habitat belong to this zone, and these changes are the basis of historical geography, which gives origin to the next tier of our pyramid, in which the influence of races of men on the earth finds a place. This may be termed, for lack of a better name, political geography; its units are uncertain and transitory, for the hold of nations on regions is subject to continual change. But political geography is stability itself compared with the rough pile of commercial geography which caps if it does not crown the edifice. Here it is no longer the racial or national view-point which determines the conditions, but the individual greedy of gain or struggling for life. The distribution of natural resources is the fundamental condition, and the national frontier has rarely much in common with the political.

But here a further simile must be brought in. This cap of the pyramid plays the part of a keystone as well, and binds the whole structure together. As rain filtering through a mass of brick or stonework dissolves the mortar of the upper parts, and redeposits it in the lower courses, so the stream of self-interest permeates the whole structure of geography, and its results are felt throughout. Commercial motives consolidate national life, accentuate racial differences, redistribute animals and plants, modify physical conditions, start investigations into the nature of the earth, and even invade the solid groundwork of mathematics with the practical counsels of common-sense.

There are many people, but there were more, who deny to the sphere of geography anything beyond the measuring of distances and the mapping of distributions. The legitimate scope of the science, however, includes very much more, and the simile which I have sketched may help some students to understand and some teachers to apply the principles of geography.

THE AGE OF THE IRON ORES OF EAST TEXAS.[1]

BY WILLIAM KENNEDY, AUSTIN, TEXAS.

EXTENSIVE deposits of brown iron ore, or limonite, occur throughout east Texas, from the State line westward to the Brazos River, and covering a roughly irregular triangular area, having its base resting upon the Sulphur Fork of the Red River across the northern side of Cass County and extending westward until the apex touches the Brazos.

Regarding the age of these deposits considerable confusion appears to have arisen. In the Tenth Census Professor Pumpelly assigns them to the Quaternary. Why this age was given to these ores is not stated. They simply appear among the Quaternary deposits in the Texas section shown on plate VIII., of the fifteenth volume, and no mention is made anywhere in the text of any authority for so placing them. As the only Texas ore of which any notice is taken in this volume is that found in Marion County, and then worked in the Kelleyville furnace, it may be presumed that, as that ore is of the nodular variety and corresponds very closely in physical appearance and approximately in chemical composition to the ores found in Mississippi by Dr. Hilgard and described by him as belonging to his Orange Sand formation, and consequently of Quaternary age, Professor Pumpelly considered the Marion County ores to have the same origin and date, and so placed them in the Quaternary when making his section.

The next investigator was Mr. Lawrence C. Johnson, an Assistant on the United States Geological Survey. Mr. Johnson had been assigned to make an examination of the iron ores of northern Louisiana in 1885, and in 1886 his instructions were modified and extended so as to enable him to examine the east Texas deposits. This investigator appears to have been the first to recognize the existence of two divisions among the ores. These he separated, assigning the name of *nodular* ore to the one variety, and by the term *lacustrine* designated the other. This latter class he again divided into "laminated" and "buff crumbly" ores, according to their texture and physical appearance.

While dividing the ores into these two great divisions, he at the same time placed them in different ages and under entirely different conditions. The nodular ore, Mr. Johnson considered as belonging to the lignitic Tertiary, and we find him, after describing the ores of Marion County, saying: "All this portion of the iron field, including Upshur, Camp, Morris, Marion and Cass Counties, is assigned to the great Lignitic of the Geological Column." (Iron Ores of Northern Louisiana and Eastern Texas, Ex. Doc. 195, first session, Fiftieth Congress, p. 34.)

[1] Read before the Texas Academy of Science, Dec. 16, 1893.

The laminated ore, or, as he described it, the lacustrine ore, Mr. Johnson appears to place in the Quaternary, as, after describing the conditions and modes of formation and deposition of such ores, he says: "Such deposits were produced at various stages of the Quaternary history of the regions under consideration, and some of them possibly during the Tertiary, and now that the strata are exposed to erosion, the hard insoluble limonites resist it more successfully than the unconsolidated sediments in which they occur; the softer rocks are therefore swept away, and the iron deposits remain upon elevated plateaus or buttes."

Mr. Johnson also appears to have recognized the existence of the extensive deposits of conglomerate ores, but of these it is unnecessary to speak. They belong to every age, from the Eocene Tertiary to the present. In point of fact, many of them are still forming.

In 1888 the Geological Survey of Texas was established and the east Texas division assigned to Dr. Penrose. This area included the whole of the ore regions examined by Johnson. In his views regarding the age of the ore deposits, as shown in his "Preliminary Report on the Gulf Tertiary of Texas," Dr. Penrose appears to agree with Johnson as to the age of the nodular ores being lignitic Tertiary, but the whole of the laminated ores he places, and rightly so, in the glauconitic or Claiborne Tertiary. In a recent report on the iron ores of Arkansas Dr. Penrose again refers to the east Texas ores as follows: "In eastern Texas, where the geologic position of the Tertiary iron ores is more easily defined than in Arkansas, two principal divisions of the Eocene contain noticeable quantities of ore; the lower one is the great series of sands and clays, which forms the central part of the Eocene (the Timberbelt or Sabine River beds of the Texas section); the upper one is the Claiborne glauconite that overlies these beds." In this report Dr. Penrose compares the Arkansas ores to the Texas nodular ores and places both in the lignitic (Report on Iron Ores, Geological Survey of Arkansas, Vol. I. of 1892, pp. 105–6).

Numerous and careful examinations of these ore deposits throughout a great portion of east Texas and particularly in Cass, Marion, Morris, Upshur and Harrison Counties, the regions in which the nodular ores are most extensively developed, have convinced me that these nodular ores do not belong to the lignitic stage of the Eocene, but rather that they are of the same age as, or probably a little newer than, or derived from, the laminated ores, which, according to Mr. G. D. Harris's determination of the fauna, are of lower Claiborne age.

Without entering into any discussion as to the geological conditions of the ore regions, it may only be necessary to say that the lignitic and glauconitic divisions are both represented in the regions occupied by the nodular ores. The characteristic features of each are so distinctly marked that there is nowhere the least difficulty in separating or distinguishing the one from the other. The uppermost number of the lignitic stage is a series of thinly stratified or laminated white and red sands and sandy clays, the laminæ rarely exceeding half an inch in thickness and having, wherever exposed, a thin covering, or uppermost lamina, of silicious iron or ferruginous sandstone from a half to one inch in thickness. These sands have not always this ribbon-like banding but occasionally, through an intermixture of the colors, present a mottled appearance. This condition is usually confined to the vicinity of streams.

The lowermost deposits of the Marine stage of the Tertiary or glauconitic deposits are usually coarse greenish or brownish-yellow colored indurated sands or sandstones. Occasionally these deposits are dark brown and usually without fossils, although not unfossiliferous throughout, but wherever found the fossils exist only as casts and are chiefly *Cardita planicosta* and turretella. These deposits are, as a general thing, ferruginous and carry laminated iron ore in thin seams, not only interstratified with the beds of sand and sandstone, but often filling joints and fractures running in different directions through the beds. No ore of any economic value, however, is found associated with them. The base of these glauconitic sands and sandstones rests directly upon the uppermost white and red sands and clays of the lignitic and marks the limit below which no ore of any quantity or value has yet been found in any portion of east Texas.

The general assumption of the nodular ores belonging to the lignitic by both Johnson and Penrose appears to have arisen from the idea held by both that the regions in which these ores occur in greatest abundance are altogether occupied by the clays and sands of that series. While it is true that the deposits of the lignitic stage are extensively developed in Cass, Marion and Upshur, and in a more limited way in Morris and Harrison Counties, the marine stage is also represented, and widely spread, fragmentary deposits of altered greensand and glauconitic sandstones occur within the limits of these counties. These fragmentary deposits often cover several miles of territory, and their presence is always marked by the occurrence of nodular ore and a greater or less extent of laminated ore. This is usually in the form of very thin seams interstratified with the sands or occurs in a fragmentary condition scattered on the surface and mixed with the geodes of nodular ore.

In Cass County the brownish-yellow altered greensands occur in association with both nodular and laminated ore at the Berry Crawford mine about a mile north of Atlanta. Here the section shows the nodular overlying the laminated ore and the underlying altered greensand resting directly upon the uppermost deposits of the lignitic series. This ridge extends for several miles to the north and west, and the nodular ore is found buried in the grayish and brownish-yellow sand forming the summit and sides of the ridge and overlying the laminated ore and altered sands and sandstones. The same thing occurs in the neighborhood of Linden, where the nodular ore occupies its usual position among the yellow sands overlying the beds of laminated ore. At Cusseta, in the so-called Cusseta Mountain, we have the same laminated and nodular ores associated with altered greensand.

Throughout the northwestern portion of Cass and eastern portion of Morris Counties extensive deposits of laminated ore occur overlying pyritiferous greensand. A small quantity of nodular ore is found along the margin of this plateau and occasionally among the brown and yellow sands overlying the region.

South of Avinger Station in the same county, and extending across into Marion County, heavy deposits of yellow and brownish-yellow sands containing great quantities of nodular ore occur, and the whole of this field rests upon the thinly stratified deposits of the uppermost lignitic, whose bright red and white striped beds show beneath the ore deposits near Mr. Lockett's mill on the one side, and the cuttings along the Texas and Pacific Railway on the other, and throughout this area wherever stream channels have been cut deep enough.

Throughout Marion County the same sequence of beds follows. Two miles north of Jefferson the banded lignitic is found occupying a position beneath the laminated and nodular ores. In Harrison County it is the same thing. In this county the marine or glauconitic

Tertiary is if anything more pronounced than in the counties to the north. Heavy deposits of altered glauconitic sands, sandstones and laminated ores belonging to the marine or Claiborne stage of the Eocene form a ridge extending through the centre of the county from nearly five miles east of Marshall to beyond the western line of the county and for over a mile into Gregg, where it is separated from the same class of deposits lying further west, by the broad bottom lands of the Sabine River. These deposits are more or less fossiliferous, containing the characteristic fauna of the marine beds found farther south and west, and rest directly upon the uppermost lignitic, exposures of which may be seen near Willow Switch in Gregg and at many places north and east of Marshall, in Harrison. Laminated and nodular ores occur scattered everywhere throughout this region. The yellow sand with its contained nodules occurs capping many of the secondary portions of the ridge and lies intermingled with fragments of laminated ore or forms portions of the ore deposits that lie scattered along the sides and around the base of the ridge.

There is no use, however, to multiply instances in which the two varieties of ore lie associated and intermingled with each other. To merely recount the localities would be long and tedious and require a detailed account of the whole geology and geography of the country.

It must, however, be admitted that as a general rule the heavier deposits of nodular ore occupy positions lying at relatively lower levels than the heavy deposits of laminated ores, and it also appears to be a settled condition that while extensive deposits of nodular ore overlie these beds, by far the most extensive and valuable of these nodular deposits occupy positions between the isolated ridges, or what may be said to form the broken ends of the marine beds. This, however, is to be expected, if we are to assume that these geodes or nodules with their surrounding sands are the products, or the results of, erosion and consequent destruction of the glauconitic beds. That these glauconitic beds extended many miles farther north of the positions in which we now find the main bodies there can be no doubt. Not only the points already mentioned, but many others not nearly so prominent, still exist, bearing witness to this northward extension and the enormous erosion which has taken place in the past and is still going on.

A careful examination of one or two of the most prominent of these deposits of nodular ore and the yellow and brownish-yellow sand will, I think, be sufficient to show that these are both the results of the degradation of the beds now forming the ridges. Macroscopically, this sand is the same as the heavy deposits found covering many portions of the regions in Cherokee, Rusk and Anderson Counties, in which the laminated ores have their greatest development. The nodules of ore found among these sands do not occur promiscuously scattered over the face of the country, but usually occur in pockets or irregular deposits and at a noticeably higher elevation than the general level of the surrounding country.

In saying that none of these ore deposits occurs beneath the thinly stratified uppermost lignitic beds, I do not mean to affirm that no ore occurs within the lignitic series, but simply that none of the great deposits of nodular ore in east Texas which have hitherto been assigned to that series belongs to the lignitic. Small deposits of a nodular variety of ore as well as clay iron-stone do occur at several places within the lignitic beds. These, however, lie at considerable depths and are found amongst the clays and sand of that series in well digging and other deep excavations. These are not all clay iron-stones nor carbonates, as has been asserted, and throughout the extensive areas of the eastern division of the State, in which the lignitic strata form the surface deposits, no ore of any kind has yet been found. The absence of these ores from the great lignitic areas of Limestone, Robertson, Smith, Harrison, Panola and other counties certainly appears remarkable if the nodular ores of Cass, Marion and others belong to these deposits.

While the question of the age of the nodular ores may form a subject for discussion, no such doubt or difficulty besets the age of the laminated ores of the region. These are altogether from top to bottom of Tertiary age and of the lower Claiborne or marine Eocene wherever found. These ores are connected with, and form an integral part of, the marine beds, and while the heaviest deposits are always, or nearly always, found at or near the surface, the same character of ore occurs at more than one horizon and lies interstratified with the glauconitic or greensand beds. Borings, as well as numerous natural sections, have demonstrated this fact,—and by the same methods it has also been shown that these lower beds are always much thinner than the upper, or surface deposits. Besides being thus stratigraphically constructed with the greensands, the ores themselves are also fossiliferous and carry the same fauna as that found in the greensand deposits. Numerous specimens gathered from deposits both overlying and underlying these ore deposits and from the ores themselves are to be seen in the cabinets of the Geological Survey of the State.

Just why these ores should assume the forms in which we now find them is somewhat difficult to say. It is quite likely that the laminated ores were deposited with the glauconitic deposits as bog iron, and part of them, particularly the interstratified deposits, have been derived from the destruction of the glauconite, and again from the destruction of these deposits, through a process of solution, infiltration and segregation, the nodular ores have been derived. Dr. Hilgard ascribes the formation of the nodular ore found in the Orange Sand in Mississippi to the solution of the iron contained in the sand and its leaching and sinking through that deposit and segregation at the base where the solution met with an obstruction to its descent in the impervious clays of the underlying lignitic beds. If this theory holds good for the Mississippi ores it certainly has everything in its favor so far as the Texas ores are concerned. There is at least one point in favor of such a theory everywhere throughout the Texas iron region. The waters found in nearly every spring and well in the country are highly charged with iron, many of them excessively so, and many of the streams crossing the ore-bearing ridges contain this impurity to such an extent that they are absolutely devoid of animal life. The waters of these streams are of a pale amber yellow color and excessively astringent taste.

Dr. Penrose's theory that these nodules are derived from nodules of clay iron-stone found in the underlying beds by oxidation—"When the carbonate has been completely oxidized the ore is either composed of concentric layers separated by cavities or is massive on the outside and hollow inside, forming geodes or iron pots. The clay or ochre often occurring in the geodes doubtless represents the residual product left after the oxidation of the impure carbonate"—does not appear to hold good in all cases. Many of the nodules found in the regions under consideration are not filled with residual ochre, but with coarse white and yellow sand, having exactly the same texture as that in which the nodules lie; besides some of the nodules found on the

ridge in Harrison County have their centres filled with silicious pebbly conglomerate, two conditions of existence which no known condition of carbonate of iron in the form of clay iron-stone could possibly create, even should we admit the existence of a sufficient quantity of that ore to form the vast deposits of iron as we now find them. The existence of the enormous quantities of carbonate of iron or clay iron-stone I am by no means inclined to admit. Whether the lignitic ever held such quantities I do not know, but certainly the beds as we now find them contain very little of this class of ore. The little they do contain is almost altogether a sulphide.

SORGHUM SUGAR.

BY T. BERRY SMITH, FAYETTE, MO.

It has been many years since the people in the central and northern parts of the United States began to cultivate sorghum for the purpose of obtaining molasses therefrom. The processes were such as could be employed by almost any farmer.

But it has been only a few years since experiments began for the purpose of extracting sugar from the sorghum cane.

The first appropriation made by Congress for large experiments in sorghum sugar making was during the last days of the session of 1884. Since that time, so far as we know, annual appropriations have been made and untiring efforts put forth to improve both the cane and the processes of sugar making; and the advances made in each line have been steady and encouraging.

It is our purpose to treat mainly of the applications of scientific principles, as made in the government experiments in Kansas and elsewhere.

Let us suppose the cane has been grown under the ordinary circumstances and is ready to be harvested. The usual course is then to strip and top the cane, cut it and haul it to the mill (who that has heard its creaking, can ever forget it?), there crush it and collect the juice, and then evaporate it to molasses by boiling in open pans, certain simple processes being employed to clarify the syrup more or less.

By such methods are obtained the molasses which we have all eaten and of which we can not mistake the peculiar flavor.

A brief analysis of the subject will show us that the main steps are:

1. Separation of the juice from the cane.
2. Separation of the sweets from the juice.

If we would manufacture sugar there must be a third step, viz.:

3. Separation of sugar from the molasses.

Let us treat these separately:

I.—Extraction of Juice.

Old Method: Expressing it by passing the cane between rollers.

New Method: Extraction by soaking in heated water, the process being termed diffusion.

The *topped* cane is delivered to the factory by the farmer. There it is cut into short lengths by a cutting machine, after which a fan blows away the boots, blades and trash, and then the short pieces are delivered to a shredding machine, which tears the cane into as small bits as possible.

This pulp is delivered to the diffusion battery, which is arranged in various ways, but the principle of which may be stated thus:

If hot water be poured over one jar of pulp it will soak out a certain amount of the sugar content. If this sweetened water be withdrawn and poured over a second jar of pulp, it will become still more sweet; and by passing it in like manner over a number of jars of pulp, it will finally become as rich in extracts as the original juice of the cane was, *i. e.*, it may be called cane juice.

Now in order to extract all the sweets, the first jar of pulp must be subjected to portion after portion of hot water, until there will be left in the pulp very little besides woody fibre. And so with the second jar and so with all the jars of pulp.

One can readily see that the jars or cells could be so connected that the hot water entering at No. 1 would be forced in succession through a sufficient number to attain the desired strength, and thus the process be rendered continuous. Such an arrangement is termed a diffusion battery.

If the subject has been made plain so far, we are now ready to take up the second great step.

II.—Extraction of Sweets.

Old Method: Simple evaporation in open kettles or pans, with constant skimming to remove the "scum" formed by heat.

New Method: (1) Neutralization of acids by lime; (2) Removal of surplus lime by carbonic acid gas (carbonatation); (3) Heating and skimming; (4) Settling; (5) Evaporation of clear juice under reduced pressure and temperature.

The *diffusion* juice is placed in large tanks and milk of lime added until an alkaline reaction is shown. The purpose of this is to counteract the effect of any acids that may be present. At this point in our paper it will be necessary to digress a little and introduce a small amount of chemistry.

There are in the vegetable world many products which are composed of charcoal and water, the only difference in chemical constitution being in the proportions of charcoal and water employed.

Let us look at the accompanying table:

Wood =	6	parts carbon and	5	parts water	($C_6 H_{10} O_5$)
Starch =	6	"	"	5	"	"	($C_6 H_{10} O_5$)
Grape Sug'r =	6	"	"	6	"	"	($C_6 H_{12} O_6$)
Cane Sugar =	12	"	"	11	"	"	($C_{12} H_{22} O_{11}$)

Now if we take wood, starch or cane sugar and boil them in water with acids, they will be converted into grape sugar. It is in this way that tons and tons of starch are annually changed into syrup and sugar for household and other purposes. Almost all of the clear thick syrups used on our tables at the present day are glucose or grape sugar syrups. Such syrup is inferior to cane sugar syrup in the matter of sweetness, three pounds of cane sugar being equal to five ponds of grape sugar in this respect. You can plainly see, then, that the effect of the acids present in the diffusion juice would be to diminish the sweetness of the syrup produced by simply evaporating without their removal. Their removal is rendered easy by the use of lime, which neutralizes them by uniting with them to form insoluble compounds which settle to the bottom. Now as lime will combine with sugar also to form sucrates, it is necessary to remove any surplus lime that may be present, and this is done by blowing through the juices a stream of carbonic acid gas, which may be inexpensively obtained from the smoke stacks of the furnaces. This part of the process is known as carbonatation.

After neutralization and carbonatation, the juice is raised to the boiling point, the scum formed by heat is removed in the usual way, and then the clarified liquid is left in large tanks to settle. From these it is drawn off and is ready for concentration by evaporation. This is not accomplished in open pans because in an

open pan the pressure of the atmosphere amounts to about fifteen pounds per square inch, and in order to raise the liquid to the boiling point this pressure must be overcome. If this pressure can be overcome, or at least largely reduced, then the boiling point can be reached at much lower temperatures than 212° Fahr.

The pressure is diminished by the use of air tight pans and of air pumps. Let us suppose that coils of pipe, connected with the escape pipe of the engine, are laid in a large pan, a supply of clarified juice fills the pan, an air-tight cover is put on, and the contained air is partially exhausted by the air pump. The exhaust steam from the escape pipe of the engine is hot enough to cause the juice to boil. Now let us suppose that the steam from this pan be forced through coils of pipe laid in another air-tight pan filled with juice and more thoroughly exhausted than the first one, it is clear to see that evaporation at a still lower temperature will be secured. Such a combination as above described is called a double-effect apparatus.

A multiple effect would be a multiplication of pans so connected and manipulated that the steam of one will boil the next. The advantages in such arrangements are: (1) lower temperature and less danger of scorching the contents ; (2) speed in evaporating the water from the sweets ; (3) reduction of cost.

Now if syrup be the end aimed at of course the process would end when a proper degree of concentration has been reached. But if it is desired to make sugar also, then additional process must be employed

III.—Extraction of Sugar.

Under this head we shall give in brief the methods employed with large success at the government experiment stations in 1891.

The diffusion process affords a juice containing both "sugars" and "non-sugars" in acid aqueous solution. As explained, the acid tends to convert cane sugar into grape sugar, and this is prevented by the use of lime.

The effect of the "non-sugars" is to prevent crystallization and separation of the "sugars" : for this reason they are called molasses-makers (melassigenes). Their removal is necessary to the formation of a large "sugar" product. Their removal is partially accomplished in the processes of defecation, i. e., liming, heating and skimming. But there still remain "non-sugars," which are soluble in water and must be separated in some other way. This is now very successfully accomplished by the use of alcohol. The clarified juices are concentrated until they contain about 55 per cent solid matter, then mixed with an equal volume of 90 per cent alcohol, and thoroughly stirred by blowing air through the mixture.

The impurities of the syrup separate in flocculent masses, and in the course of twenty-four hours they completely settle to the bottom of the tanks, leaving a supernatant fluid that is clear and of a pleasant odor.

The next step is to draw off the clear fluid and subject it to distillation, whereby the alcohol is separated and recovered for future use. The sediment is subjected to pressure by which an alcoholic syrup is obtained and a hard cake left containing more or less of sugar and alcohol. Here is the chief loss of alcohol, but the loss may probably be more than replaced by fermentation and distillation of these "press cakes." Here, however, we encounter the United States revenue laws, and modifications would have to be made in the laws before sugar factories could proceed. In fact, the alcoholic process would require so much alcohol that it cannot be profitably employed unless the sugar manufacturer could be allowed to buy, or manufacture, and use alcohol, almost or altogether free of duty. What legislation has been had in regard to this subject we are not prepared to say.

"The syrup, freed from alcohol, was passed through the usual sugar house processes of granulation in the vacuum pan and purging in the centrifugals." (Bulle-

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tin No. 34, experiments with sorghum in 1891, by Prof. H. W. Wiley.)

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It is doubtful if cane can be profitably raised more than three miles from a central factory, and besides enough cane can be raised within two miles of the factory to supply all of its demands. Such being the fact, the central and northern States must hope to make their own supply of sugar, not by individual factories, but by a system of central factories put up on a large scale and equipped for all the steps of molasses and sugar making.

The amount of sugar consumed in the United States for the year ending June 30, 1890, was about three billion pounds (an average of fifty-five pounds per capita), and there were eighty million gallons of molasses consumed.

The United States produced about one-tenth of the sugar and one-fifth of the molasses. Hence the necessity for increasing our sugar producing crops, viz.: the southern cane and the northern sorghum and the beet.[1]

[1] To these may be added "corn cane," for a most interesting discussion of which the reader is referred to *Science* during the month of September, 1893.

—The third annual meeting of the Ohio Academy of Science was held at Columbus on Dec. 28 and 29, 1893. The usual necessary formal business was done, and papers were read on various subjects connected with geology, botany, entomology, ornithology, and a beginning was made in chemistry and astronomy, which have not previously claimed their fair share of attention. The following among the papers read may claim notice here: "On the Evolution of Indian Corn," by Mr. W. A. Kellerman; "Distribution of North American Lepidoptera in Norway," by Prof. F. M. Webster; "On Certain New and Known Marine Infusoria," by Dr. D. S. Kellicott; "Lake Licking; a Contribution to the Buried Drainage of Ohio," by Prof. W. G. Tight; "Further Study of the Wheat Scale," by Prof. A. D. Selby; "On a New Fossil Crustacean from the Water-Lime," by Prof. E. W. Claypole; "A Revision of the Lichens of Ohio," by Mr. E. E. Bogue, and "On the Nutritive Value of Common Fruit," by Prof. W. R. Lazenby. Arrangements were also completed for the organization of a Natural History Survey of the State. Three directors were appointed, Professors Claypole, Kellicott and Kellerman, whose duties were simply to enlist and arrange all the volunteer laborers who could be induced to take part in the work and aid them in the choice of fields and in the prosecution of their labors, leaving the whole method or responsibility in their hands as much as if they were independent workers. These results when obtained will be presented to the Academy, by the authors if possible, referred to suitable experts and, at the discretion of the Academy, printed in the annual report. The organization of the undertaking is the most important one of the still young academy. Prof. F. W. Webster, of the Agricultural Experiment Station, was elected president for 1894.

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CONTENTS.

Bauxite Mining. Henry McCalley..... 29
A South American Lamprey. Theo. Gill..... 30
Notes on the Geology of the Gold Field of Cripple Creek, Colorado. H. L. McCarn..... 31
The Synthetical Powers of Micro-Organisms.—I. O. Loew..... 35
Current Notes on Chemistry.—V. Edited by Charles Platt..... 37
Continental Phenomena Illustrated by Ripple Marks. Richard E. Dodge..... 38
Letters to the Editor:
Another Rope of Maggots. William Hayes Ward..... 39
Secret Language of Children. D. T. Marshall..... 39
Notes on Water Lilies, Etc. J. McNair Wright..... 39
Book-Reviews..... 40

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AND

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PRINCETON UNIVERSITY

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CONTENTS.

President's Address before the New York Meeting of the American Psychological Association: GEORGE TRUMBULL LADD.

The Case of John Bunyan (I.): JOSIAH ROYCE.

Studies from the Harvard Psychological Laboratory (I.):
Memory; The Intensifying Effect of Attention; A Psychometric Study of the Psycho-physic Law; Optical Time-content; A Stereoscope without Mirrors or Prisms (with Plate I.): HUGO MUNSTERBERG.

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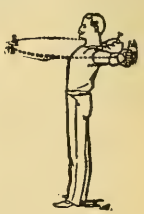

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SCIENCE

NEW YORK, JANUARY 19, 1894.

BAUXITE MINING.

BY HENRY M'CALLEY.

BAUXITE mining in America is a new thing, only a few years old, and hence its methods, etc., are known to but few. Four companies have been engaged in it, viz.: Republic Mining and Manufacturing Company, formerly of Hermitage, Ga., now of Rock Run, Ala., the pioneers in the business; Southern Bauxite Mining and Manufacturing Company, Piedmont, Ala., Georgia Bauxite Company, Linwood, Ga., and the John D. Taylor Bauxite Company, Summerville, Ga. Only the first two of these companies, however, are now actively engaged in the work, the Georgia Bauxite Company having laid off a few months ago until the tariff question is settled, and the Taylor Bauxite Company having never done anything more than to develop the quality and extent of its deposits. The two companies now actively engaged in the work have mines in both Georgia and Alabama, though they both, in 1892, concentrated all of their forces in Alabama, in the "Dyke District," Cherokee County, and so they are not now working their Georgia mines. They each have in the "Dyke District" two mines, though the Southern Bauxite Mining and Manufacturing Company are at present working only one of theirs. These mines consist of nothing more than irregular holes, diggings in the ground, on the sides of hills, with deep, open drainage channels, or ditches, leading off from them and with graded ways leading down into them. In other words, they are the counterparts of limonite and manganese diggings, with the addition of the drainage channels, the ore occurring very much as do the limonites and manganese, in irregular or ill-defined beds or deposits in residual clays. It is, however, more or less stratified, or, in other words, follows the strike and dip of certain strata.

The mining of the ore is made easy by its comparative softness below the surface, being usually soft enough to be dug up with a pick. It is, however, expensive to mine, from the fact that it is so variable in quality that it has to be condensed and assorted. The ore in the same mine often changes from one quality to another, sometimes suddenly and sometimes gradually. It is condensed and assorted by means of the screen and the hand.

The mining implements are of the most simple kind, consisting of only the pick, shovel, churn-drill, wheelbarrow and tram-car. The ore has to be dried before it is shipped, as it has a very great affinity for hydroscopic water. This drying is done at present by simply spreading the ore out over the yard and under the shed; and leaving the rest to the sun and the winds. The preparatory work, therefore, in commencing to mine bauxite consists in leveling off a yard, building a shed, building of a road or track to the dump piles, and the securing of perfect drainage for the mine.

As now conducted, the drying process goes on only during favorable weather, and hence at the expense of much time and often of completeness. This will doubtless be corrected as soon as the profits of the business will admit of the additional outlay of capital for the erection of artificial driers. The present method of mining will, of course, have to be varied some, as the diggings get too deep to be drained by open ditches, and as bedded rocks are struck, provided the deposits still hold out. No bedded rocks as yet, other than the ore itself, have been struck in any of the mines.

The Alabama ores have, up to this time, invariably improved with depth, though, in some of the Georgia mines, the ores have deterioriated, or have increased in iron and silica with depth. The best variety of ore now makes up most of the shipments, and so the inferior ores, though many of them of very good quality, are accumulating at the mines. This is to be regretted very much, especially since nearly all of the present shipments are used for the manufacture of alum, and a much inferior ore, or one much higher in iron and silica, might just as well be used for this purpose. This shipment of only the best ore is, however, a necessity, from the fact that these new enterprises have to meet in competition old and well established shippers of cheap foreign ores. They have been so successful in this competition that they have about killed the import trade. If the shipment of the best ore first was not a necessity it would be nothing more than what might be expected, as it would be simply repeating the history of all new mining enterprises at their very beginning.

The three mines that are now in active operation are known as the "Washer or Taylor Bank," "Dyke or Burst-Up Bank" and the "War-Whoop Bank." The first two, on the property of the Bass Furnace Company, are leased and worked by the Republic Mining and Manufacturing Company. The last one is owned and worked by the Southern Bauxite Mining and Manufacturing Company. These mines are in a broken country, from three to four miles to the northeast of Rock Run furnace, to where the ore has to be hauled in wagons to be loaded on the cars. One of these companies employs from fifteen to twenty hands and the other from fifteen to forty, exclusive of the teamsters. This ore now costs, as stated by one of the companies, about $3.45 per long ton, loaded on the cars at Rock Run furnace. The exact cost, however, as stated by this company, is hard to get at, as, the mines being new, a great deal of expense for prospecting and dead work has properly to be taken into account to get the cost per ton. The cost per ton at the different mines would, therefore, probably vary materially from each other.

The "Washer or Taylor Bank or Mine" has now reached a depth at its back or deepest part, next to the hill or ridge, of some forty feet. It will hardly be dug any deeper until there is provided some other means of keeping it dry than the present open ditch. It is proposed to drain it to a still lower depth of some twenty feet by means of a tunnel or drift that will start in some distance away at the foot of the hill. The ore is continuous across the mine in the direction of the strike, a general northeast and southwest direction, though the strike is in waves. The dip, in a general way, is from 30° to 40° toward the northwest. The deposit, however, is irregu-

lar, and little can be known about it until it has been laid bare The ore is about thirty-five feet thick in the mine. It is concretionary or pisolitic and is of very good quality. The upper twenty feet is better ore than the lower fifteen feet, and the best of all is an inter-bedded seam of four to five feet in thickness. An average sample of the mine is said by Mr. John H. Hawkins, superintendent of the Republic Mining and Manufacturing Company, to have about the following analysis:

Alumina	61.00
Ferric oxide	2.20
Silica	2.10
Titanic acid	3.12
Water (Com. and Hydro.) and loss	31.58
	100.00

The "Dyke or Burst-Up Bank" in its back or deepest part is from twenty to twenty-five feet deep. Its ore is divided into two irregular seams by an unctuous clay of white, blue and mottled colors. On the outcrop the ore over the clay is near thirty feet thick, and that under the clay has been dug into to a depth of some twenty feet, though its full thickness cannot be seen. In the mine the ore does not appear to be so thick. The bottom bauxite has in it some spots of bauxitic clay and some streaks of manganese stain. The general strike is to the northeast and southwest, and, in the mine, the dip is near 30° toward the northwest. An average sample of the ore of this mine is said to have about the following analysis:

Alumina	58.21
Ferric oxide	3.60
Silica	2.90
Titanic acid	3.40
Water (Com. and Hydro.)	31.89
	100.00

The "War-whoop Bank," in its back or deepest part, is some twenty feet deep. The different varieties of ore of this mine are known by the commercial names of "War-whoop Ore," "Bird's-eye Ore," "Purple Ore," "War-whoop Bobo Ore" and "Hard White Ore." The "War-whoop Ore" has a putty or dove-colored matrix. The "Bird's-eye Ore" is the "War-whoop Ore" with decomposed matrix; it is inferior in alumina and is so thrown into the waste dump. The "Purple Ore" is "War-whoop" stained, presumably with manganese; it is also thrown over the dump. The "Hard White Ore" has a very white matrix; and the "War-whoop Bobo Ore" is a flour-like ore of about the same composition as the "Hard White Ore." These different ores occur as in the following section, made by Mr. R. S. Perry, general manager of the Southern Bauxite Mining and Manufacturing Company, along a straight line across the mines, commencing with the top ore:

		Feet.
(10)	"War-whoop Ore," about	13
(9)	"Bird's-eye Ore," about	8
(8)	"War-whoop Ore," about	10
(7)	"Purple Ore," nearly	3
(6)	"Clay Horse," a little over	3
(5)	"War-whoop Ore," with 3 inches of (4), nearly	3
(4)	"War-whoop Bobo Ore," nearly	3
(3)	"Hard White Ore," nearly	9
(2)	"War-whoop Bobo Ore," soft, something over	2
(1)	Clay, underbed, white for several feet and then mottled.	

The following analyses are given by Mr. R. S. Perry as the average of those made by the consumers of car-load samples of the "War-whoop" and "Hard White" ores of the "War-whoop Bank or Mine."

	1.	2.
Alumina, from	57.00 to 62.00	56.00 to 62.00
Ferric Oxide	under 1.00	2.50 to 3.00
Silica, about	2.50	5.00
Titanic Acid	3.00 to 4.00	3.00 to 4.00
Water, Combined	29.00 to 30.00	about 30.00
Moisture, Hydroscopic	2.00 to 4.00	3.00 to 4.00

(1) The "Hard White Ore." Average analysis of car load samples of between 500 and 1000 long tons.

(2) The "War-whoop Ore." Average of consumers' analyses.

The company contemplates driving a tunnel from near the bottom of an adjacent ravine under the "War-whoop Bank or Mine." This tunnel would drain the ore to a depth of some forty feet under the present floor of the mine.

The bauxite mining in America, or in Alabama and Georgia, is gradually on the increase, and, unless nipped in the bud by unfavorable legislation, promises to be of no little importance.

A SOUTH AMERICAN LAMPREY.

BY THEO. GILL, WASHINGTON, D. C.

In September, 1867, a lamprey was found in a street of Buenos Ayres and was the cause of much comment, some conjecturing it to have fallen from the heavens (!) and others that it was transported by a water spout. A valuation of 15,000 pesos (dollars) was placed on it, and subsequently it was actually sold for 1,000 pesos. (This was, however, in the much depreciated currency of Argentina.) Later the species was described by Dr. Burmeister as *Petromyzon macrostomus*. In 1882 I ventured to propose for it the generic name *Exomegas*. In 1893 it was re-described and figured by Dr. Carlos Berg, the successor of Dr. Burmeister, as *Geotria macrostomus*. Another specimen was found near Montevideo in 1890, and on it Dr. Berg's communication was based. The description and figure do not, however, entirely agree, and to call attention to such discrepancies is the object of this note. It is to be hoped that Dr. Berg will further examine the specimen and elucidate the doubtful points.

From Dr. Berg's illustration, it is evident that the lamprey is not a *Geotria* and that the genus *Exomegas* based on it is perfectly valid. It is not clear, however, what is the character of the annular cartilage, and, from the figure, one might even be excused for thinking it might not be developed. Such want, however, is very improbable.[1] If there should really be no annular cartilage the lamprey so distinguished would have to be referred to an independent family at least.

Dr. Berg says: "*Lamina maxillaris angusta lobulis quattuor valde humilibus fere inermis instructa,*" but not the slightest indication of such a corneous lamina is given in the accompanying plate. Only four concentric (not at all diverging) rows of conic teeth are represented as arming the upper half of the oral disk, and one row of numerous (24) teeth is delineated in a marginal lower row. Is there really an upper or suproral lamina, and can the lower teeth possibly be developed from tubercles of the annular cartilage? Dr. Berg says: "*Lamina mandibularis humilissima mutica.*" Let us hope that Dr. Berg will dissect the subject sufficiently to inform us, and give us a better illustration. Either the figure of Dr. Berg's memoir is quite inaccurate, or the species deviates remarkably from all other Petromyzonids in dental arrangement. I may add that in common with all others of late years, I have adopted for the family the name *Petromyzontidæ*, for which Professor Agassiz (1850) was responsible. The proper form of the name is *Petromyzonidæ*.

[1] The shape of the mouth sufficiently indicates the existence of an annular cartilage.

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Attention is called to the "Wants" column. It is invaluable to those who use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

NOTES ON THE GEOLOGY OF THE GOLD FIELD OF CRIPPLE CREEK, COLORADO.

BY H. L. M'CARN, DENVER, COLO.

THE granites surrounding the mineral district of Cripple Creek are of the ordinary types common to the Front Range. They vary from moderately fine to coarse grained in texture. Bedding structure is generally rather indistinct, but in places is strongly marked, and the rock may be more correctly styled gneiss. The quartz in these granites is either of a vitreous translucent or milky variety; the feldspar (orthoclase) usually pink. Biotite is the common mica, but other micas are met with, especially close to the mineral belt; one of these varieties being a black mica with splendent lustre, sub-translucent and dark green by transmitted light. It is strongly iron-bearing, very easily fusible to a black globule and is undoubtedly closely allied to, if not identical with, lepidomelaur.

In the granite ridge bounding the town of Cripple Creek on the west, are seen veins of amorphous, white or rose quartz, often six inches or more in thickness, apparently dispersed without relation to bedding structure, or order of any kind. Similar veins consisting wholly of pink feldspar occur in the same manner. Nests of large tabular prisms of a black mica (lepidomelaur) are also met with. Much of the granite here is of a very coarse texture, the various constituents being often an inch or more in diameter. These veins of quartz and feldspar, the nests of mica, as well as the very coarse textured granites, may all be attributed to a common cause, and have every appearance of having been formed contemporaneously with the consolidation of the containing granite. To the east of this ridge, in the town, as well as in other parts of the district, there occur "endogenous" veins of quartz, associated with parallel veins of feldspar, which are two or three feet in width and may be traced some distance in approximately straight courses. These veins are probably of secondary origin—concretionary veins—due to causes similar to those to which the various alteration belts of rock of the mineral area may be attributed. From the normal granites surrounding the district, towards the centre, occur innumerable phases of altered granitic rocks. Schists, aplites, felstones, conglomerates and breccias abound in numberless varieties, and transition rocks have been observed linking together rocks of very different appearance. Although this region is laid down on Hayden's maps as "eruptive," no true eruptives were seen *in the mineral belt proper*, with the exceptions of a black magnetic dyke in the town, and the rock composing what is known as "Bull Cliffs." These eruptives will be discussed further on. To give distinctive names to the various altered rocks of the district would be as difficult a task as attempting to name the shades from blue to green. Some sort of a classification of the most marked types should, however, be made. The nomenclature in use by the miners is confusing in the extreme and renders an attempted description of the country rock of a mine unintelligible. Granite, schist, porphyry, quartzite and trachyte are the miners' rocks. The term granite is applied to the binary granites as well as to the normal granites, if the rock is coarse-grained and the feldspar still pinkish, but if the feldspar is white, some call it "porphyry," while others speak of it as "quartzite," the choice of terms depending, probably, on their individual preference for the one or the other as a country rock for their claims. These micaless granitic rocks are from course to fine granular in texture—some even passing into a microcrystalline aggregate. In color they range from white, through bluish-gray and gray, to yellow or brown. Some are pyritous, some mellose, in a fine grained magma, porphyritic crystals or blotches of white feldspar; while others have a leached-out appearance and are often colored yellowish or brownish by iron oxides. Curiously, this last-mentioned type is the one universally called "porphyry" by the miners. It composes the walls of many of the best mines (especially near the surface at depth passing into a grayish, often pyritous felstone) and is a favorite country rock. In the veins it often forms a veinstone, seamed with secondary quartz carrying gold. This so-called "porphyry" is sometimes beautifully zoned with concentric rings of brown or yellow, due to the oxidation outward of iron salts—the rusty bands giving the rock a riband appearance. The interior of such rocks is generally found to be a fine granular, gray material somewhat resembling sandstone, and often containing small grains of white iron pyrites. The micaless granites, where coarse in texture, might be termed "aplites," the fine-grained varieties "felstones." By prefixing descriptive adjectives, such terms as porphyritic gray felstone, pyritous felstone, yellow or brown felstone, etc., etc., would convey some idea of the character of the rock under discussion. There are two distinct mica schists in the camp. In one the mica is a black iron-bearing variety, the rock often appearing to be a disintegrated granite with schistose structure and very friable. This rock is considered an unfavorable country rock. The other schist is a tough, laminated, white rock, the mica being in large leaves of glistening, silvery-white muscovite (or a hydrous alteration variety of muscovite). This latter rock occurs in bands through the heart of the mineral area and in one or two instances was seen apparently bedded with beds of coarse granular, white "aplite" lying conformably upon its dipping surfaces. Some good mines are found in this rock, or rather on its contact with other rocks. The "Bull Cliffs" eruptive is locally called trachyte. The term is not, however, confined to this eruptive, but is given to many dark varieties of rock, of various structure, some of which bear a strong eruptive appearance in hand specimens. Some of these rocks are hard and compact, ring when struck with a hammer, and often contain small grains or prisms of hornblende. These rocks are usually in dark shades of gray and are occasionally exquisitely traced with imitative figures resembling trees, ferns, etc., due, doubtless, to a saturation of the rock with water, which, acting on

the hornblende or irons in the rock, decomposes these minerals. Capillary attraction brings the solution to the surface, where the mineral matter is deposited in the forms mentioned.

Careful examination, wherever exposures showed contacts with other rocks, failed to show any evidence of heat or local metamorphism of any kind. Transition rocks found in the immediate vicinity, as well as in other parts of the district, seem to furnish most of the links between these eruptive appearing rocks and well recognized metamorphic rocks. The absence of visible glassy enclosures, the mode of occurrence, and the fact that intermediate varieties occur, afford evidence that these rocks are simply alteration products of the granites. They might be termed "hornblendic felstones." Types of these rocks have been noticed as patches or masses included in the bedding of alteration granites, where they have the appearance of being due to some concretionary process, whereby they have become segregated into patches more basic than the balance of the formation. Belts of conglomerates and breccias occur in the district, and many good mines are found in such formations. The above mentioned altered granitic rocks comprise the most marked types, but the various varieties graduate one into another by innumerable transitions.

Evidence of bedding is often plainly discernible in these rocks, but stratigraphical study is very difficult owing to the "wash" or "slide" that covers the rocks, sometimes to a depth of sixty or eighty feet. Exposures are rarely to be seen except in the excavations made in prospecting and mining. Some of the belts of altered rock appear to be the upturned edges of regular bedded deposits, but in most cases they seem to be *zones of alteration*, and usually have a more or less northerly and southerly trend. Many of these belts are impregnated with iron pyrites (always to some degree auriferous) and constitute impregnated zones similar to what are termed "fahlbands." The gray pyritous felstones occur in this manner. As before stated, these rocks, especially where they have been leached of their auriferous pyrites and colored brown or yellow by the iron oxides resulting from the decomposition of the pyrites, are the rocks always spoken of in the camp as "porphyry." It is not surprising that the veins occurring in these rocks are so rich in gold, but it must not be understood that it is the only favorable country rock of the district. A number of excellent mines have solid granite walls, and others equally good occur in the various formations heretofore mentioned. The disintegration of the granites has resulted in giving the hills gentle rounded slopes, instead of the cliffs and bold escarpments such as make up the grand, precipitous scenery of Cheyenne Cañon and the other beautiful cañons around Pike's Peak. This disintegration is going on at the present time in the rocks at a little depth from the surface. In one tunnel on the northwest slope of Bull Mountain, at a depth of perhaps 200 feet, and 400 or 500 feet from the mouth, the micaless granite is found saturated with water. The formation is broken up similarly to what is termed "loose formation," met with near the surface in most mines. The rock is, some of it, so rotten as to fall to pieces in handling, though at rest it looks to be firm, with the feldspar porphyritically developed. Examination shows the feldspar to be kaolinized and soft and the rock very friable. Two or three veins have been cut by this tunnel, and in these veins kaolin seams and earthy oxide of manganese are forming, so that one can see *mineral veins in process of formation*. Gold is found in these seemingly unfinished veins, but where cut by the tunnel, they are understood to be "low grade." It may be well to say here that in this district, as in fact in most mining regions, the richest ore occurs in "shoots" or "courses," and a vein may be opened by shaft, or cut by a tunnel, in a comparatively barren part. Drifting on such a vein will often develop richer ore without, necessarily, any particular change in the outward appearance of the ore. In this event an "ore shoot" has been cut, which may extend longitudinally no great distance, but vertically, or downwards at various inclinations, it may extend to great depths. This characteristic of mineral veins has been the cause of many good mines being abandoned, on account of cutting through an "ore shoot" and "losing the ore."

The broken up condition of the rock in the tunnel above alluded to is probably a result of the disintegration going on, portions of the rock, for some reason, resisting the action of water, etc., better than the other parts, thus leaving angular or rounded fragments unaffected. These fragments become cemented together afterwards by mineral matter from solutions, and thus form conglomerates and breccias, such as are found in the belts heretofore alluded to, as well as in the mineral veins.

The veins of this district are, in most cases, unquestionably, true fissures, and "sheeting" of the country rock parallel to the main fissures is a characteristic of many of them. The fissures seem to diverge from several centres in directions between 45° each way from north and south, and but few veins occur nearer east and west than 45°. Where bedding structure can be discerned, the veins are found to cut the bedding either transversely, or at greater angles from the horizontal than the dip of the beds. The fissures evidently did not remain open to any great width, but sufficient cracks remained to permit the circulation of water through them. Mineral solutions have eaten out the faces of these cracks, and replaced the eroded material with silica and gold in the form of vesicular or crystalline auriferous quartz, together with iron and other vein minerals. Professor Emmons in a valuable paper ("Structural Relations of Ore Deposits," Trans. Am. Inst. of Min. Eng. Vol. XVI.) describes the parallel cracks which often accompany fissure veins as "minor fractures which form the adjacent country rock into parallel plates or sheets." There are many excellent examples of such sheeted fissure veins in the district, and it is largely these quartz-filled parallel cracks that yield the richest ore. In many mines the highest grade ore is the finely divided "screenings" resulting from the breaking up of their quartz seams by the blasts. The "clay partings" are also often rich in gold. Many veins have only one well defined wall—the other being so eaten into by mineral solutions as to alter it into ore. Sometimes both walls are thus altered. A kaolin selvage is often found on the defined wall, and in one mine in particular a "slickenside," composed of limonite, was seen taking the place of the clay selvage on a portion of the nearly vertical foot-wall. This "slickenside" was highly polished and striated, the groovings dipping at an angle of about 30° from the horizontal. Many walls are found hardened and grooved, where a regular "slickenside" was impossible, on account of the absence of the right sort of material necessary for its formation. These phenomena afford evidence of a movement of the walls and grinding action only met with in true fissures.

The veins are often mineralized to a considerable distance into the country rock, making it impossible to measure the width of the vein. In one mine belonging to the "Anaconda Group" the rock was quarried out to

a width or thirty feet or more. This mine is a good example of a great "sheeted" fissure—the sheets or plates varying from a few inches to two or three feet in thickness and separated from each other by nearly vertical quartz seams often rich in gold. There is also in this mine, a rich pay streak of vesicular quartz, wad and kaolin, which perhaps occupies what may be considered the "main fissure." The little quartz seams are the "minor fracture cracks" filled with secondary auriferous quartz, and the "sheets" or "plates" the country rock mineralized and changed into low grade ore. Seams and partings of kaolin (the talc or china-clay of the miners), as well as the selvages referred to, are common. Such seams are often followed downward, through the "slide" or "wash," which is generally the top beds decomposed *in situ*, and lead to good veins in the solid formation. Much of the ore is coated and impregnated with fine, white, auriferous iron-pyrites, associated with graphic tellurium (sylvanite), forming a rich and valuable ore. Some of this sylvanite ore is very beautiful as well as valuable—the surfaces being stained a rich blue verging on purple, by fluoric acid, and glistening with fine silvery white bars of sylvanite.

Few valuable minerals besides gold are found in the district. Silver is very seldom met with—the trifling amounts found in the ore being of no commercial importance. Copper is still rarer. Limonite is met with as a vein stone, and, in two or three instances, as a cap to the lodes. It seems to carry little gold, as a rule. Earthy oxide of manganese (wad) occurs in the veins with kaolin. A quartz peculiar to the district is the granular, sugary, massive quartz, often colored blue or purple by fluoric acid. This rock or ore contains a little orthoclase in grains, and is probably a felstone again altered by the mineral solutions circulating through the veins. In many mines it is rich in gold. Galena is very rare, but it is occasionally seen in the form of very small grains in vein stones. In one mine, fine anglesite crystals are found in geodes in a vein rock containing small grains of galena. They are small, tabular, white crystals of adamantine lustre, and result, doubtless, from the decomposition of the galena. Most of the vein matter is simply altered country rock—the kaolin resulting from the decomposition of the feldspar. The vein quartz is the silica which was separated from the silicate (orthoclase) and held in solution in the alkaline waters at the time of the kaolinization of the fieldspar. The iron and *gold* may have been derived from the iron-bearing micas (perhaps directly in some cases, or from pyrites which were themselves derived from the micas) and held in solution in the same alkaline waters that held the silica. These alkaline waters, circulating through the fissures, impregnated the walls and plates, and filled the cracks with auriferous quartz, together with the other minerals of the solutions. Surface water containing organic matter may have aided in precipitating the minerals. One of the most interesting and peculiar vein-stones here found is the variously colored jasper occurring in considerable quantities in the "Victor Mine" and to some extent in others. In the "Victor" the bright-colored cryptocrystalline jaspers are said to be very rich in gold, while the dark-brown earthy-looking varieties carry little or no value. This is very surprising, but a visitor will find very little of the first named variety "on the dump," while in the ore house he will find men carefully sorting and sacking ore for the smelters, and here he can see large quantities of jasper, some striped in shades of red, white and light brown, all of it going into the ore sacks. Sulphate of baryta (heavy spar) was noticed in one mine—associated with crystals of pyrite. Celestite, tourmaline and a few other interesting minerals occur, but are very rare. The mineral veins are, as a rule, singularly free from minerals valuable only to the mineralogist.

While the Cripple Creek mining district must be considered a typical granitic region, the two isolated eruptives heretofore mentioned are interesting to geologists and petrologists. The Black Dyke traversing the northwestern part of the district is at least thirty feet wide. It is questionable whether it reached the surface at any point, until erosion carried away the overlying granites and schists. Where partially excavated in the town, it lies in a belt of black, friable mica schist, but was not sufficiently uncovered to show the contact on either side. Further northwest on a spur of the granite ridge, which bounds the town on the west, this dyke is seen cutting through the granite, and some local metamorphism is apparent at the contact. Here it seems to have thrown out an arm; or rather, it looks as if, unable to force its way higher, the pressure from below was sufficient to force the granite beds upward a little, forming a space into which the molten or plastic matter found its way horizontally. Underlying this arm or sheet, between it and the granite, is a horizontal vein of white, massive, quartz, six inches in thickness close to the dyke, but gradually widening to two feet or more, forty feet away. The eruptive sheet becomes thinner as the quartz vein grows thicker, so that, taken together, they measure about the same throughout their course. The granite, which doubtless overlaid both, has been eroded away. Some prospector has opened the quartz vein by an open cut to the dyke, and tunneled some feet into the dyke itself. The quartz vein, where covered by the eruptive sheet, is strongly impregnated with copper pyrites, and coated blue and green by copper carbonates. Forty feet from the dyke the eruptive sheet comes to an end, and the quartz becomes white, losing all trace of copper. This is the only place in the district proper where evidence of copper was noticed, and it is clear, in this case, that the copper was derived directly from the eruptive rock. Macroscopically this dyke rock is a basic, compact, almost aphanitic, rock, very dark gray or almost black in color and showing minute, metallic grains disseminated throughout the mass. A polished surface, with the aid of a pocket lens, shows fine feathery flakes of a plagioclase feldspar; the interstitial spaces being filled with a black or very dark green mineral (amphibole or pyroxene). This rock resists erosion well but weathers brown, slightly, on exposed surfaces. Its age is hypothethical, and microscopical study will be necessary to determine its petrological name.

The eruptive forming "Bull Cliffs" is of an entirely different character, and is known in the camp as "trachyte." It is a micro-crystalline rock containing glassy crystals (sanidine). A part of the deposit contains considerable hornblende in grains and prisms. The upper beds, however, contain little or no hornblende and are of a fine mottled greenish-gray and white appearance. This rock splits into slabs, often as thin as one-eighth of an inch with smooth surfaces. It resists erosion much better than the underlying hornblende-bearing rock. The latter disintegrates readily; exposed surfaces have a hackly appearance, and are spotted white with a decomposition product of the rock. The hackly weathered surfaces are often so friable as to crumble off in handling. Large blocks ring almost like steel when struck with the hammer. Hydrochloric acid eats out a considerable part of the rock (probably the nepheline). This eruptive does not seem to occur as a dyke, but rather as an isolated, massive eruption

of some kind. It is a variety of "phonolite." The writer does not believe that the two eruptives described have any bearing on the origin of the gold of this origin. Fire tests on the "phonolite" failed to reveal a trace of gold, and, as yet, no "pay mines" have been found in close proximity to the Black Dyke. The evidence all seems to point to the granite as the source from which the gold and other vein minerals were derived. Micas have been found by the work of Sandberger and others to contain nearly all the heavy metals (according to Phillips, gold, tellurium and mercury, "from want of the necessary appliances were not sought for" by Sandberger); and it would not be unreasonable to expect that future researches may reveal traces of gold in some of the micas of this region. If this prove to be the case, it would not be difficult to form some conception of the manner in which the different changes, which made up the evolution of great gold veins from granite beds, took place. This paper has attempted to convey some idea of the tremendous alteration and working over by aqueous agencies, to which the rocks of this region have been subjected. If there is an analogy between this alteration and the occurrence of the gold, the *degree of alteration* would satisfactorily account for the great richness of the deposits, and afford much promise of permanence and value at great depths. The bands or zones of alteration were caused by the action of underground waters. There is no reason to believe that these waters were of a *very high temperature*, but that they were hotter than ordinary surface waters is undoubted. Subterranean waters are waters from the surface which have descended through cracks or by percolation through the porous rocks. As stated by Presturch, "the higher temperature of the waters at great depths would give rise to convection currents which establish a constant removal of the mineral matter in solution from deep-seated sources." The meeting of hot waters from below, charged with solid contents derived from the rocks, with surface waters, would reduce the temperature of the ascending waters; and the precipitating agents brought down by surface waters would bring about the deposition of the mineral matter in the interstitial spaces left by the removal of the matter originally therein. The process would thus be a constant interchange of matter—abstraction and replacement. In this way if minerals or rocks of a different character from those existing near the surface were met with and acted upon by these waters great changes could be produced; but, if the rocks were practically the same to great depths, as is likely the case in this region, the alteration produced would be simply changes in the texture of the rock, and in the proportions of the different constituents. These molecular changes would afford opportunities for the segregation and concentration of minerals, and would account for the concretionary veins of quartz and feldspar, heretofore described, as well as the zones or belts impregnated with auriferous pyrites. The micas of the granites would be acted upon; the iron and gold contained in the mica (if the mica held gold) changed into sulphates in solution, which were in turn reduced by the organic matter brought down by waters from the surface, to metallic sulphides (or the iron to a sulphide holding the gold in a finely divided metallic state), and deposited in the pores of rock already rendered porous as described above.

Accounting for the derivation of the sulphur necessary for the formation of sulphates is the one link missing in the chain of reasoning which makes up the theory of "lateral secretion." The votaries of the "ascension" and "sublimation" hypotheses hold that the sulphur must come from deep-seated sources, but they do not satisfactorily explain why it should be present at depth and not in the rocks a few thousand feet above. Neither do they tell us whence comes the sulphur in the great sulphide lead, zinc and copper ores of the upper Mississippi lead region. There the ore occurs in chamber deposits or flats in unaltered Silurian limestones; no eruptives of any kind are met with; and, so far as known, no fissures or other connections have existed, or do exist between these beds and the rocks underlying them at depth.

The atmosphere seems to have been, so far as the writer knows, not considered as a possible source from which the sulphur required for these reactions may have been derived. The carbon necessary for the formation of coal was derived from the atmosphere, and most geologists hold that the air must have contained a larger amount of carbonic acid at the beginning of the Carboniferous period than at the present time. Much sulphur is often present in coal. Is it unreasonable to conjecture that, during those early periods, the air contained gases which are no longer present, or only present in infinitessimal quantities? Great difficulty has always attended analyses of air, but the examination of rain water has thrown much light on the impurities contained in the atmosphere. Geikie says: "Nitric acid sometimes occurs in marked proportions—sulphuric acid likewise occurs, especially in the rain of towns and manufacturing districts. Sulphates of the alkalies and alkaline earths have been detected in rain." He attributes the disintegration of mortar in walls to the action of nitric and sulphuric acids of the air and says: "The mortar of walls may often be observed to be slowly swelling out and dropping off, owing to the conversion of the lime into sulphate." The Colorado Front Range is believed by geologists to have been raised above the sea, as a long, narrow, northerly and southerly island, at about the close of the Archean era; but not upheaved, into a great mountain range, until the close of the Mesozoic. There was thus ample time for the slowest kinds of chemical and molecular changes to take place in. Atmospheric erosion, during these countless centuries, must have carried away several thousand feet of the top beds. To make up for this waste, it is probable that the land was at times upraised to some extent. These sporadic upliftings would likely be accompanied by more or less disturbance of the strata; fissures would be produced, in the areas of greatest disturbance, which would form channels for the circulation of waters; and thus aid in the alteration of the country rock into the bands or zones heretofore described. It was during this period that the sulphur was probably introduced. Whether it was derived from the air and brought down by surface waters, or from the seas bordering this long island, through infiltration, or introduced from below in some manner, is as yet an unsolved problem. In the formation of these belts of alteration and auriferous pyrites "fahlbands" was the first stage in the genesis of these gold deposits; and "lateral secretion," aided by "ascension," which is a necessary adjunct to the *circulation* of underground waters, seems to account for the first stage, as well as for the more recent one of concentration into veins rich enough to work. At the close of Mesozoic time this long, narrow island, which had, for untold ages, existed as land, was thrown up into a mountain range. It was during the folding and contortion of these rocks, attending their upheaval, that the fissures, since filled with auriferous quartz, were probably formed. Enormous lateral pressure caused these great peaks and anticlinal ridges. A torsional

force acting in conjunction with this lateral pressure, would, as shown by Daubreé, cause fractures to occur on the sides of the folds, in the direction of the axis of elevation, or nearly so. These combined forces would, also, according to Daubreé and Emmons, cause the fractures to occur in more or less parallel groups, and would account for the minor fractures or sheeting structure so characteristic of this district. Most of the metalliferous fissures in the district are thus found on the sides of the anticlinal ridges, more or less parallel to their strike, and cutting the bedding vertically or at a much greater angle than the dip of the beds. When such fissures cut belts of pyritous felstone, it seems to be the invariable rule, that some portions, at least, of their course will be found rich in gold.

Waters containing carbonic acid and other solvents acting on the pyrites and orthoclase would decompose them and carry the iron, gold and silica in solution through the fissures. The iron and silica were precipitated as limonite and vein quartz, but the gold, for some reason, was not evenly deposited with the other minerals, but was segregated into "shoots" or "courses" through the veins, the portions of the veins lying between these "ore shoots" being "low grade" or comparatively barren. It is possible that these "ore shoots" owe their richness to their position in the old channels through which surface waters, containing organic matter, or other precipitants, flowed with greatest freedom.

The brown and yellow felstones, commonly called "porphyry" in the camp, are, as before stated, the pyritous felstones leached of their auriferous pyrites, in the manner described, and colored as they are by iron oxides. Much of the gold in the veins may have been derived by a more direct process from the micas, and did not undergo the intermediate stage of deposition with pyrites in zones of impregnation.

No sign of glacial action is apparent in the district, and no large streams are found in the close vicinity of the mines. The valleys or gulches are synclinal troughs rather than valleys of erosion. The products of surface or atmospheric erosion, *since the formation of the mineral veins*, remain for the most part *in situ*—the lack of transporting agencies, such as glaciers or flooded streams, accounts for the thickness of the "wash" and the comparative absence of alluvial gold in the streams draining the district. Placers occur as often on the *tops of the hills* as in the valleys. Some of the decomposed material from the very summits of the hills has proved so rich in gold as to well pay for transporting in wagons to the stamp mills.

If water for hydralicing was available most of the "wash" would yield rich returns.

No attempt has been made in this paper to describe the many really great mines of the district. The writer has simply endeavored to show the connection or analogy between the alteration of granitic rocks and the occurrence of the mineral in veins. If the cause of the concentration of mineral matter into veins is "lateral secretion," it is evident that the greater the chemical and molecular alteration the country rock has undergone, the greater the richness of the veins will be. If this hypothesis is the true explanation for the origin of the gold, the magnitude of the country rock alteration will easily account for the great richness of the mines so far discovered as well as insure their permanence and future value.

In conclusion the writer desires to say that the area under discussion in these notes includes only the mineral belt in which the present pay mines are located. It embraces about fifteen square miles, and does not include the mountains to the north and west, such as Rhylorite Peak and Mt. Pisgah, which, judging from their appearance at a distance, and the testimony of others, are probably of eruptive origin.

THE SYNTHETICAL POWERS OF MICRO-ORGANISMS—I.

BY O. LOEW, UNIVERSITY OF TOKIO, JAPAN.

AMONG all living organisms the micro organisms, micrococci as well as bacteria, bacilli and spirilli, are especially remarkable by their intensity of chemical activity. Oxydations and decompositions, reductions and synthetical processes are executed on an extensive scale. Numerous organic combinations are easily split up, and under atomic migrations substances of a more solid structure are formed, the products of fermentative actions. And amid this destructive activity, while the fight against easily changeable compounds is raging, there is built up in the interior of the cells the most labile of all combinations, the active albumen, being organized to living protoplasm. And this is done, under favorable conditions, with such rapidity that one cell can yield by growth and continual fission in twenty-four hours more than one trillion of new cells! What an energetic manufacture of living protoplasm, of living cells!

If we consider the destructive and synthetical operations, we must arrive at the conclusion that the former are necessary for carrying on the latter; the former yield not only the forces necessary for the synthetical work, but also the suitable atomic groups. It is certainly a highly interesting question of physiological chemistry to study the relations of the two different directions, and to elucidate which the groups are that serve for the synthetical work. In order to see our way clear we must at first consider the chemical structure of the combinations that can serve as nutrients, we must investigate the causes that bring about the transformation of potential into actual energy, and we must recognize, above all, that the proteids of the living protoplasm are chemically distinct, are different from those of the dead; we must acknowledge that when the labile character of the former changes by atomic migration to a stable one the death of the cells has come.

Nutritive and poisonous qualities are relative conceptions, poisons may become nutrients for bacteria when highly diluted, as phenol or acetic ether, and nutrients may become unfit for nutrition if the concentration reaches certain limits. Small chemical changes may convert a nutritive substance into a poison, and again the poison into an indifferent substance; thus the methan is indifferent, the methylic alcohol a nutrient, the methylic aldehyd a poison and the combination of the latter with bisulfite of sodium again indifferent, and even for a certain kind of bacterium a nutrient.

CH_4	$CH_3 OH$	$CH_2 O$	$CH_2 OH—SO_3 Na$
Methan	Methyl alcohol	Methylic aldehyde	Methyl sulfonate of sodium.

Also the quantity of the produced fungoid matter depends a great deal upon the chemical constitution of the nutrient. Thus I have observed with cultures of mould fungi that tannin or tartaric acid yields only 10/12 per cent of their weight, acetic or succinic acids, however, 14/20 per cent, when nitrogen is present in form of ammonia salts. The more oxygen atoms are contained in a compound the less, naturally, will be the relative production of fungoid substance, but it makes a difference as to whether the oxygen atoms are present in form of carboxyl groups or in form of "alcoholic" hydroxyl groups. The easier a substance is decomposed, the more readily it will be used, and the quicker the development of cells will take place.

What substances then can be used as nutrients, can contribute to the multiplications of cells, *i. e.*, for the formation of more protoplasm, of albuminous matter? As albuminous matter contains carbon, hydrogen, nitrogen, sulfur and oxygen[1], we have to consider principally the questions: Which substances are suitable sources for the carbon, which for the nitrogen, which for the sulfur? Numerous experiments made by Nägeli and myself lead to the following conclusions:

1. As sources of carbon can be used in neutral or weakly alkaline solutions; alcohols, phenols, organic acids, ketones, aldehydes, carbohydrates, ethers and esters, many alkaloids.

2. As sources of nitrogen can serve: Ammonia salts, nitrils, amido acids, amins, ureas, guanidins, alkaloids, nitrates and nitrites.

3. As sources of sulfur can serve: Sulfates, sulfites, hyposulfites, sulfo acids, mercaptans, sulfons.

Now of all these substances, so very different in chemical structure and character, the bacteria can form synthetically the same albuminous matter, the substance of their own protoplasm. There can be no doubt that in all these different cases the same proteids result, otherwise the structure and functions of the kind of bacterium grown in these solutions would change, and new species would be formed with ease, according to the difference in food. Now, if we want to get an insight into this remarkable process, we must at first consider which substances are the fittest sources of carbon, which are neither useful nor poisonous, and which are directly noxious?

In regard to the first question we must draw from numerous observations the following conclusions for most of the non-pathogenic forms of microbes:

1. Hydroxylated acids are better than the corresponding non-hydroxylated ones, *e. g.*, lactic acid, $C_3 H_6 O_3$, is better than propionic acid, $C_3 H_6 O_2$.

2. Polyvalent alcohols are more favorable for the development than the corresponding monovalent ones; for instance, $C_3 H_6 O_3$, glycerin, is better than propylic alcohol, $C_3 H_6 O$.

3. The nutritive quality of the fatty acids and monovalent alcohols decreases with the increase of the number of carbon atoms in the molecules; for instance, acetic acid, $C_2 H_4 O_2$, is better than butyric acid, $C_4 H_8 O_2$; methylic alcohol, $CH_3 OH$, is better than amylic alcohol, $C_5 H_{11} OH$.

4. The entrance of aldehyd or keton groups increases the nutritive qualities: glucose, $C_6 H_{12} O_6$, is better than mannite, $C_6 H_{14} O_6$; acetyl acetic ester is better than acotic ester (in 0.1 per cent solutions).

5. Neither noxious nor nutritive properties have been observed by me with picronitric acid, chloralhydrate, pinakon, ethylendiamin, glyoxal, amidoacetal; very poor nutrients are acetoxim, diacetonamin and maleinic acid.[2] (These substances were applied in neutralized solutions containing 0.1–0.5 per cent). According to B. Meyer also mesaconic, citraconic, paramethyl succinic, dimethyl succinic, and benzoyl succinic acid are incapable to serve as food.[3]

6. The poisonous qualities are determined by the energy with which the labile atom groups of the living protoplasm are attacked; chloroform, phenyl, hydrazin, formic or methylic aldehyd may be mentioned here.

Those observations permit us to draw certain conclusions as to the group useful for synthetical purposes. If methylic alcohol is better than amylic alcohol, then the group serving for synthetical purposes will be, of course, more easily prepared from the former; the same is true for acetic acid compared with butyric acid: we are forced to the conclusion that the group for commencing the synthesis of albuminous matter is a very simple one, with only one atom of carbon, and as methylic alcohol as a saturated compound cannot be used as such, the group in question can only be methylic or formic aldehyd. Neither can acetic acid be used as such; it must be converted into a substance suitable for condensating processes, and this cannot be anything else than formic aldehyd also in this case. If this conclusion be correct, then we understand why substances containing the group CH OH are very favorable for nutriment and increase in their useful qualities with the number of these groups (the polyvalent alcohols, the polyvalent acids). We understand also why such substances are capable to nourish certain bacteria endowed with fermentative properties, even in *absence of air*, while substances without this group can be used as food only in presence of air, oxydation being then necessary to form this group. But how is that conclusion possible, if formic aldehyd is a poison? No doubt this seems an objection of weight; but if we consider how easily the formic aldehyd is changed under condensating influences, and how indifferent simple combinations of this aldehyd are, the objection appears no longer so serious; we must only adopt the view that the formic aldehyd undergoes rapid transformations, and that no molecule formed remains unchanged for a second.

If certain substances, as picronitric acid, chloralhydrate, pinakon, cannot be used as nutrients, we may find the reason in this, that those substances offer too much resistance to the bacteria for the production of formic aldehyd; hence no albuminous matter can be synthetically prepared, the living protoplasm cannot grow, not increase, the formation of new cells becomes impossible. It is also simply explained, why oxalic acid cannot be used as food; it can neither by oxydation nor by splitting yield formic aldehyd. Neither are the salts of formic acid suitable nutrients, the conversion into formic aldehyd being rather difficult. I have observed only one kind of bacterium that is able to grow in diluted (0.5 per cent) solutions of sodium formiate; it occurs in the dust of air and forms reddish pellicles.[4] The conversion of formic acid into formic aldehyd by this microbe might be explained by the following equations:

$$\left.\begin{matrix} \text{H-CO OH} \\ \text{H-CO OH} \end{matrix}\right\} = \left\{\begin{matrix} \text{CHO} \\ | \\ \text{CO OH} \end{matrix}\right. + H_2O$$

2 Mol. formic acid; glyoxylic acid

$$\left.\begin{matrix} \text{CHO} \\ | \\ \text{CO OH} \end{matrix}\right\} = CH_2O + H_2O$$

Formic aldehyd.

[4] Centralblatt f. Bacteriologie, 1892, XII., No. 14.

(To be continued.)

[1] We leave here the nucleins out of consideration, they contain phosphoric acid in their molecule.

[2] he is-meric fumaric acid is, however, a good nutrient.

[3] I may add that methylamin is a better source of carbon than trimethylamin.

—The December election of officers of the Wilson Ornithological Chapter of the Agassiz Association resulted as follows: President, Willard N. Clute, Binghamton, N. Y.; Vice-President, Reuben M. Strong, Oberlin, O.; Secretary, William B. Caulk, Terre Haute, Ind.; Treasurer, Lynds Jones, Oberlin, O. The chapter is in a very flourishing condition, with seventy-three active, four honorary and thirty-one associate members. The past year has been devoted to a special study of the Warblers, and the forthcoming report promises to make a very interesting paper. Any information regarding the chapter will be cheerfully furnished by the secretary.

CURRENT NOTES ON CHEMISTRY.—V.

[*Edited by Charles Platt, Ph.D., F. C. S. Lond.*]

Education of Industrial Chemists.

Among the most valuable of the papers presented at the World's Congress of Chemists were those in discussion of industrial chemical education. Any four years' collegiate course in chemistry may graduate an analyst. one who is content to remain forever a laboratory employee grinding out results,—and parenthetically let it here be said, that the young graduate need expect nothing but a "grind" in any laboratory. He may have dreams of research and private study, but a few months' time will dispell these with unpleasant forcibleness. He will find that each day brings a mass of routine work, and chemical analysis rapidly degenerates into mechanical manipulation. We do not say this by way of discouragement; analysts are necessary, and many find here the greatest pleasure in their work, but there is needed, too, another class of workers, not higher in dignity maybe, but different in kind; we mean chemical engineers, or, to use the rather awkward designation, industrial chemists. By this we mean men capable of taking hold of the greater operations of the chemical works, capable to superintend, to construct, to alter and improve machinery, to interpret analytical results and to use them in the refinement of processes; in other words, men to comprehend the process as a whole, not only the chemical reactions but also the mechanical means used in their perfection. It is a simple matter to dissolve, precipitate, filter, and dry, in the laboratory, but how is this to be done when there are thousands of gallons to be handled, and this, too, with the greatest economy of labor, of power, and of time? It is true we have catalogues describing apparatus, etc., but of twenty patterns which is to be adopted? An experiment will cost thousands of dollars, and yet it is only the best, the most suitable type of apparatus which will allow the manufacturer to enter the market with his competitors. More than likely, too, *none* of the apparatus catalogued will exactly answer the conditions, and alterations must be made.

It may be said in truth that the chemical engineers of to-day are born, not made, for while there is a beginning in two or three of our technical schools the ideal course in chemical engineering is still of the future. It might be added, however, that the technical schools are the only places in the country in which to learn chemistry for practical purposes of any kind whatever. The larger universities, even those with elaborate post-graduate courses, are fitting preparation for teaching and scientific research, but not for the industrial laboratory.

Reduction of Phosphates and the Preparation of Commercial Fertilizers.

A practical process for the reduction of phosphates in which carbonic acid is substituted for the usual mineral acid has been proposed by C. Seybold and F. Heeder, (Deut. landw. Presse, 20, 1883, No. 64). The simplicity and increased applicability of the new process makes it of great interest in the production of fertilizers. The procedure is as follows: The phosphate is finely ground, moistened with water and spread in a chamber heated gradually to 120° C, through which a current of carbonic acid with steam is passed. The successive steps are represented by the formulæ:

$$Ca_3(PO_4)_2 + CO_2 + H_2O = CaCO_3 + 2\,Ca\,H\,PO_4$$

$$2Ca\,H\,PO_4 + CO_2 + H_2O = CaCO_3 + CaH_4(PO_4)_2$$

The alkali-calcium phosphates are prepared by the addition of carbonate of potash or soda to the moistened phosphate:

$$2Ca_3(PO_4)_2 + K_2CO_3 + H_2O + CO_2 = 2Ca_2\,HK\,(PO_4)_2$$

$$2Ca_2\,HK\,(PO_4)_2 + K_2CO_3 + H_2O + CO_2 = 2CaH_2\,K_2\,(PO_4)_2$$

The by-products are omitted in the above equations. In the preparation of nitrogenous fertilizers the organic nitrogenous substances (hair, hoof, leather, tanhage, etc.,) are dissolved in alkali carbonates with the addition of lime, or in caustic alkalies alone, and the ground phosphate is placed in this solution and treated as described above. To obtain a nitrogenous fertilizer of the composition of ordinary guano, 500 pounds of nitrogenous refuse is dissolved in 50 parts of carbonate of potash decomposed with heat by 50 parts of caustic lime, and 500 – 600 parts of bone meal are added. In the reduction of bone meal the process is as follows: The material is finely ground and mixed with about half its weight of water and spread in the drying oven. Steam is admitted with the gaseous products of combustion, the temperature being kept at about 60°–80°C. The time of treatment necessary, is reduced when alkali carbonates are used. The end product is regulated by the amount of alkali used, by the temperature of the oven, and by the duration of treatment. Among the advantages claimed for this process are the absence of injurious sulphates and the production of a cheap available phosphate, utilizing heretofore rejected nitrogenous substances.

Volatilization of Metals and Oxides in the Electric Arc.

M. Moissan continues his interesting experiments at high temperatures, and the results are as before almost incredible. Condensation in these present experiments is obtained by the introduction of a copper **U**-tube, through which a rapid current of cold water is continually passed, immediately above the crucible in the furnace. Asbestos board is placed above the opening through which the **U**-tube is introduced. Magnesium pyrophosphate in the arc produced by a current of 300 ampères and 65 volts produces a sublimate of magnesium oxide and ordinary phosphorus. Asbestos completely volatilizes in a few minutes under 300 ampères and 75 volts. Copper with 350 ampères and 70 volts volatilizes rapidly and condenses in globules. In contact with the air cupric oxide is formed. Silver readily boils and distils, condensing in globules, or in a gray powder or in aborescent fragments. Platinum melts almost immediately and very soon begins to volatilize, condensing in brilliant globules or in powder. So also aluminum, tin, gold, manganese, iron, uranium, carbon, calcium oxide and magnesium oxide all melt, boil and distil over!

Zirconia heated in an electric arc of 360 ampères and 70 volts rapidly melts and in a few minutes is in rapid ebullition. If the zirconia be mixed with an excess of carbon, a residue of zirconium carbide is left, containing from 4.22 to 5.10 per cent of carbon. If this be fused with excess of zirconia pure zirconium is obtained, Sp. Gr. 4.25, scratching glass and ruby easily. A button of zirconium is also obtained as a residue by fusion of zirconia in the electric arc in absence of an excess of carbon. Silica in an arc of the same intensity melts almost immediately and in a few minutes is in complete ebullition.

Native Soda, Wyoming.

H. Pemberton, Jr., and G. P. Tucker give analyses of the deposits of sodium sulphate occurring in the dry region of the high Wyoming plateau, near the town of Laramie. The lower and greater portion of these de-

posits, known as the "solid soda," consists of a mass of crystals mixed with a considerable amount of black slime. Analysis shows: Na_2SO_4, 36 per cent; $CaSO_4$, 1.45 per cent; $MgCl_2$, 0.77 per cent; NaCl, 0.21 per cent; H_2O, 46.87 per cent; insoluble residue, 13.86 per cent. The upper part of the deposit from 3–12 inches thick is formed by solution from the upper layers of the lower part, and by subsequent evaporation or cooling of the solution. Calculated as anhydrous, the composition of this upper portion is: Na_2SO_4, 99.73 per cent; $MgCl_2$, 0.26 per cent; insoluble matter, trace. The article, however, as prepared at Laramie is said to be not so pure.

Artificial Pyroxenes, Etc.

A CONTRIBUTION to the artificial production of minerals in a general method for the production of anhydrous crystallized silicates is described by Dr. Hermann Traube. The amorphous hydrated silicate is precipitated from a solution of the salt of the metal by the addition of a solution of sodium silicate. The precipitate is heated to a high temperature for several hours with boric acid, and the anhydrous silicate is finally obtained in good crystals. Ebelmen has already prepared the mineral pyroxene by this method, but Dr. Traube extends its application to any of the corresponding metallic salts. For instance, beautiful crystals of zinc bi-silicate, $ZnSiO_3$, are obtained by precipitating the hydrous silicate from a solution of $ZnSO_4$ by addition of sodium silicate. The precipitate is ignited with eight times its weight of fused boric acid and finally the boric acid not volatilized is leached out with water. The crystals of $ZnSiO_3$ occur as transparent prisms with domal terminations. By the same method the mixed silicates of this class may be obtained.

Stereochemistry and Motochemistry.

IN view of the recent extended study awarded this comparatively new field in chemistry, historical notes of its earlier conception become of interest. In addition to the hints regarding geometrical arrangement in space offered by Swedenborg, Wenzel, Biot, and some others, we have the same ideas foreshadowed in the writings of Wollaston and Ampère—quoted by Prof. John C. Cain, of Owens College, Manchester, in a recent letter to *Nature*. Wollaston in his paper entitled, "On Super-acid and Sub-acid Salts" (Phil. Trans., Vol. XCVIII, 1808) discusses the constitution of the two oxalates of potash: "When our views are sufficiently extended to enable us to reason with precision concerning the proportions of elementary atoms, we shall find the arithmetical relation alone will not be sufficient to explain their mutual action, and that we shall be obliged to acquire a geometrical conception of their relative arrangement in all the three dimensions of solid extension . . . When the number of one set of particles (combined with one particle) exceeds in the proportion of four to one, then, on the contrary, a stable equilibrium may again take place if the four particles are situated at the angles of the four equilateral triangles composing a regular tetrahedron... It is perhaps too much to hope that the geometrical arrangement of primary particles will ever be perfectly known."

The same idea was developed later by Ampère in his "Letter to Berthollet" (1814), in which he considers the molecules as forming various geometrical figures dependent on the number of atoms contained therein.

Under the designation "Motochemistry" M. E. Molinari has recently discussed the hypothesis that the constitution of compounds is dependent on the intromolecular movements of the atoms in relation to one another, rather than on their relative positions in space. The bonds by which it is customary to represent the union of atoms are taken as expressing the nature of the swing or energy of the atoms with regard to each other.

CONTINENTAL PHENOMENA ILLUSTRATED BY RIPPLE MARKS.

BY RICHARD E. DODGE, CAMBRIDGE, MASS.

A FEW days ago I saw at Winthrop Beach, Mass., some peculiar features of ripple marks that I thought might be of interest to the readers of *Science*.

Walking along the beach close to low-water mark, I noticed from a considerable distance a large number of peculiar markings upon the surface of the ripple marks, with which the shore was extensively corrugated. The sand of which the ripple marks were composed was very micaceous and much mixed with fine mud, so that it held a large amount of water between the particles. There was also a thin film of water on the surface of the deposits, partially held in position, I suppose, by cohesion. The ripple marks had an amplitude of about eighteen inches, and in the hollows between two adjacent marks the film of water was somewhat thicker than on the sides, so that a shallow basin was thus formed, bearing the same relation to the sloping sides of the ripple marks that the ocean itself bears to the adjacent continents.

After having noted the conditions mentioned above, I saw that the peculiar markings were due to the erosion caused by the water running down the sides of the ripple marks toward the hollows. The seaward sides of the marks were being worn away and dissected by a small river system developed thereon, and the waste thus derived was being deposited in the adjacent hollows. We have thus in these ripple marks, left uncovered by the receding tide, constructional forms similar to what we might expect to see when a warped coastal plain emerges from beneath the ocean.

As we would normally expect on such a constructional surface, we had developed at once a drainage consequent on the slope and structure of the materials of which the slope was composed. The streams, small as they were, followed all the laws of the largest continental streams, at once deepening mouthwards and lengthening headwards toward the divide formed by the crest of the ripple marks. Such small river systems were developed at frequent intervals along the slope of the ripple mark, each one having numerous tributaries and assuming a digitate form so familiar in rivers.

As soon as the small stream reached the level of the half-inch film of water in the basin between the ripple marks, erosion ceased and deposition began. In front of each small stream there was building out into the basin a small delta, but very broad and as deep as was the layer of water. The discharge of the minute fragments of waste from the streams was so rapid that I could watch the growth of the delta with ease and could note the building forward of the frontal slope and the building up of the top slope to the surface of the water, as has been described by Prof. W. M. Davis in his description of the growth of glacial sand plains. We thus had forming a small continental shelf similar to that off the eastern coast of the United States at the present time.

A more careful study of the processes in operation in these basins showed me that at certain places the small streams were developing alluvial terraces and at others building alluvial plains according to whether the stream was over or under-loaded with waste to be carried down

the slope. At one place I found that the crest of a ripple mark was cut by a small transverse channel draining the basin above the mark into the one below. Such a small channel must have been formed by an antecedent stream, that is, one in operation and maintaining its course across the rising fold as it emerged from the ocean. Such a river is the Green River described by Powell.

In a word we seem to have in these small ripple mark basins that I have described an epitome of the destruction of continents, of the formation of the continental shelf and the evolution of geographic form as brought about by subaerial denudation. The erosive work was particularly similar to that of an ordinary river because the water running down the slope was very slight in amount. The rills were not formed, as are ordinary rills, by the flowing back to the ocean of the water held in a considerable hollow of the beach. They were formed by the small amount of water held in the spongy material of the ripple marks and pulled down toward the hollows as the level of the water under the surface lowered with the receding tide. The amount of water thus being less than usual in the formation of rill marks, the process was slower and the result more delicate and more similar to ordinary subaerial erosion.

In was interesting to note that the erosion took place only on the seaward side of the ripple marks and the shoreward sides were left undissected. The reason for this seems to be that the water held in the sands was pulled vertically down by gravitative action and hence was drawn through between the particles of the beach deposit toward the next hollow on the seaward side. In this respect only, as far as I could see, did these small streams differ from the streams on a similar constructional slope in the more consolidated rocks of the continents.

It would seem from this instance and others that have been called to my attention from time to time that nowhere do we have such a chance to study dynamical geology in operation on a small scale as at the sea shore. Apart from the work of the ocean itself there are a large number of things similar to what I have mentioned above that are worthy of careful attention, even though they be small. One thing especially that can be studied to great profit at this time of the year is the shore work of frost and ice. I feel that our ocean shores have not been studied in sufficient detail in the past, and I am sure that no better place can be found to show erosive processes in their entirety than the sea shore at low tide.

LETTERS TO THE EDITOR.

***Correspondents are requested to be as brief as possible. The writer's name is in all cases required as a proof of good faith.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Another Rope of Maggots.

The note by Mr. Lynds Jones in *Science* of December 29 recalls a similar observation by myself. I was hastening to a train and observed a rope of maggots, such as is described by Mr. Jones, crossing my path, which I at first took to be the skin of a snake. It was on what is called the Gully Road in Newark, N. J., and the maggots were crossing the path from the gully of the road. I kicked it and noticed that the maggots appeared to be clinging to each other, so that they separated in flakes. I had not time to look, but I presumed that they were moving away from a carcass which had been exhausted. A year later along the same road I noticed in the gully the body of a dog which was being consumed by maggots, but I observed, when the food was exhausted, that they moved down the rocky gully not in a rope, but one by one, and scattered along, slender and emaciated, for a distance of perhaps fifty feet. William Hayes Ward.

New York, Jan. 12, 1894.

Secret Language of Children.

Mr. Oscar Chrisman's article in *Science* of Dec. 1, 1893, recalls to my mind the "Hog Latin" that I and my school-boy companions used to use, and by means of which we were able to carry on conversations which were altogether unintelligible to our parents and teachers.

Our "Hog Latin" was formed by transferring the first consonant sound of a word to the end of the word, and then adding long *a*, as in the words doubt = oubt-da, book = ook-ba, house = ouse-ha.

Long words were sometimes split up into syllables, and these syllables treated as shorter words, as: Language = angla-agegwa, suspect = us-sa-ect-spa. This language was defective in that it did not sufficiently disguise those words which begin with a vowel, as: Are = are-a, either = either-a, any = any-a. We used to get around that by avoiding the word I; using *me* instead, or by placing the accent in the wrong place, as: Either-a, calling it *ee*-thra.

I remember that I learned to use the language in a day or two, and after a short time did not have to stop to think how to make a new word, but was guided by the sound entirely.

A couple of sentences will suffice to explain the language:

Where are you going this morning? *Ere-wha are-a oo-ya oing-ga is-tha orning-ma?*

When this language is spoken rapidly it is difficult for those not in the secret to catch what is said. *En-wha is-tha ang-la-edge-gwa is-a oken-spa apid-ra-e-la it-a is-a iffi-da-ult-ca or-fa ose-tha ot-na in-a e-tha e-sa-et-cra oo-ta atch-ca ot-wha is-a ed-sa.* D. T. Marshall.

Metuchen, N. J.

Notes on Water Lilies, Etc.

J. E. Todd in *Science*, No. 567, mentions a "miniature water lily." Another variety of a very small water lily grows at Hyannis Port, Mass., in a long abandoned mill pond. None other of the numerous ponds in that locality, where water lilies grow abundantly, possesses this small and beautiful variety. The blossom is an exact copy of *Nymphea odorata*, and is but one-half inch in diameter; the leaves also, in shape, color and venation, are like those of *N. odorata*, and are but one and a half inch in full diameter. I did not look up the plant last summer, but had found it for several years before, and will search for it when I return to the shore.

Several notes on "coon-cats," etc., recalled to me a very large black and white tom cat, at Hyannis Port, a notable mouser, having the peculiarity of *double fore feet*. All the feet of this animal are particularly large and strong, and on the outer side of each fore foot grows a second paw more than half as large as the normal one. This cat was a vigorous digger; to effect entrance to a basement under my porch, he dug a large hole at an angle of 45° and about eighteen inches deep, passing under the boarding, and large enough for him to crawl

through, but smaller at the inner opening than the outer. Having entered by this means he seemed unable to increase the hole by digging from the inside upward and could not return as he came. When one hole was blocked up by stones, he dug from the outside another, but could never leave the basement unless the doors were opened for him.

In regard to "late blooming trees," I had a flowering almond which bloomed in April, then again in October, and again in April. It was a young shrub, and grew vigorously. I concluded that the October blooming was provoked by very mild, moist, showery, spring-like weather, which continued long enough to develop the flower buds, and then hasten the growth of the next set of embryo buds, to a point where they were ready for blooming on the return of good growing weather.

J. McNair Wright.

BOOK-REVIEWS.

Handbook of Experiment Station Work. A Popular Digest of the Publications of the Agricultural Experiment Stations in the United States. Bulletin No. 15. Washington, D. C., Office of Experiment Stations, U. S. Department of Agriculture. 1893, 411 p.

As mentioned in its title, this bulletin is a popular digest of the work of the experiment stations of the United States. That such a publication is a useful one and serves a very useful purpose is manifest when it is known that there are fifty-four different stations in the country, some maintained entirely by the general Government, some by the several States. These stations had during the year 1892 no less than $997,244 at their disposal, and of this sum $689,542 was from the national treasury. That the stations have done some good work cannot be denied; but that there has been a large amount of duplication without sufficient justification, and a large amount of useless expenditure also, cannot be denied. The Secretary of Agriculture in his last annual report very properly protests against the charging against the Department of Agriculture the sum of over $700,000 annually when the Department has nothing whatever to say in regard to its disbursment. "No detailed account," he says, "as to how the money has been expended, to whom, or for what it has been paid out, is required. Current rumor in some of the States and Territories, so universal, pronounced, accentuated, and vehement as to have secured great credence, indicates that some of the moneys appropriated for experiment stations have been diverted from legitimate public purposes and turned to those of a personal and not patriotic character." He rightly thinks that if the Department is to be charged with the sum it should have the supervision of its expenditure. There are about 500 persons employed in the different stations, and during 1892 alone there were published fifty-five annual reports and 250 bulletins. With such a mass of literature as this to cope with the necessity of some digest is at once evident.

The first regularly organized station was at Wesleyan University, Middletown, Conn., in 1875; but as a result of the law passed by Congress in 1887, giving $15,000 annually to every station organized, *now* every State and Territory except Montana and Alaska have stations, some States have two, and several have three substations.

The volume under review was originally designed as a part of the exhibit of the World's Fair at Chicago, but it has only recently been issued. The various subjects are arranged alphabetically, and while not pretending to be a manual or encyclopedia of agriculture it will at the same time serve as a ready means of ascertaining what has been done upon many subjects of importance in agriculture. Under each heading there is given a brief notice of the subject and at the end refer-

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ences, more or less numerous, to station publications where further information can be secured if desired.

It is of course impossible to refer in detail to all the subjects. A reference to a few will probably be of interest. Under *Chrysanthemum* we read that experiment showed it to be possible to keep pollen of the plant for five days and still retain its vitality. It is observed under *Dandelion*, quite extensively used as "greens" in spring, that it has been studied in Minnesota, and directions are given for cultivating it. Geological work is not extensively carried on, only four geologists being employed, and these being engaged in studying soils. Numerous varieties of grasses are discussed, over ten pages being devoted to them. In a short note upon Leguminosæ numerous references are made to investigations upon root-tubercles. Their value in taking nitrogen from the air and storing it in the soil is considered very great, and it is stated that by growing the tubercle-producing plants and plowing them under they form manure for wheat and other crops requiring considerable nitrogenous material. The article upon *Milk* refers to the value of late researches upon bacteria causing fermentation, souring of cream, etc. Those bacteria causing red milk, ropy milk, etc., can be prevented by cleanliness. Those which are useful in butter and cheese making can be utilized. The aroma of butter has been determined to be due to a specific bacterium, and the ferment produced by this is being used to a certain extent in Germany and Denmark. In the ripening of cream there is a conflict of many varieties of bacteria and the problem has been to separate that one which will give the best results. So, too, with cheese-making. The ripening of cheese is due to the action of micro-organisms. The number of these has been found to be from 25 to 165 millions per ounce. The conclusion reached is that in the future "the butter-maker will separate the cream by the centrifugal machine in as fresh a condition as possible and will add to the cream an artificial ferment consisting of a pure culture of the proper bacteria, and then ripen his cream in the normal manner. The result will be uniformity. The cheese-maker will in like manner inoculate fresh milk with an artificial ferment, and thus be able to control his product. Perhaps he will have a large variety of such ferments, each of which will produce for him a definite quality of cheese. To the dairy interest, therefore, the bacteriologist holds out the hope of uniformity. The time will come when the butter-maker may always make good butter and the cheese-maker will be able in all cases to obtain exactly the kind of ripening that he desires."

Under the head of *Phosphates* there is an interesting account of the different kinds, with analyses of those found in South Carolina and Florida. Perhaps the longest article in the volume is upon the weeds of the United States, nearly 20 pages being devoted to them. A list of the weeds with common and scientific names and station publications where referred to occupies thirteen pages. Finally in an appendix there are given a number of tables of analyses, of feeding stuffs, vegetables, fruits, nuts, commercial fertilizers, farm manures and ash constituents of woods. The volume is, upon the whole, one of the most useful which has ever been issued by the Department of Agriculture.

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When lightning-rods were first proposed, the science of energetics was entirely undeveloped; that is to say, in the middle of the last century scientific men had not come to recognize the fact that the different forms of energy—heat, electricity, mechanical power, etc.—were convertible one into the other, and that each could produce just so much of each of the other forms, and no more. The doctrine of the conservation and correlation of energy was first clearly worked out in the early part of this century. There were, however, some facts known in regard to electricity a hundred and forty years ago; and among these were the attracting power of points for an electric spark, and the conducting power of metals. Lightning-rods were therefore introduced with the idea that the electricity existing in the lightning-discharge could be conveyed around the building which it was proposed to protect, and that the building would thus be saved.

The question as to dissipation of the energy involved was entirely ignored, naturally; and from that time to this, in spite of the best endeavors of those interested, lightning-rods constructed in accordance with Franklin's principle have not furnished satisfactory protection. The reason for this is apparent when it is considered that the electrical energy existing in the atmosphere before the discharge, or, more exactly, in the column of dielectric from the cloud to the earth, above referred to, reaches its maximum value on the surface of the conductors that chance to be within the column of dielectric; so that the greatest display of energy will be on the surface of the very lightning-rods that were meant to protect, and damage results, as so often proves to be the case.

It will be understood, of course, that this display of energy on the surface of the old lightning-rods is aided by their being more or less insulated from the earth, but in any event the very existence of such a mass of metal as an old lightning-rod can only tend to produce a disastrous dissipation of electrical energy upon its surface,—"to draw the lightning," as it is so commonly put.

Is there a Better Means of Protection?

Having cleared our minds, therefore, of any idea of conducting electricity, and keeping clearly in view the fact that in providing protection against lightning we must furnish some means by which the electrical energy may be harmlessly dissipated, the question arises, "Can an improved form be given to the rod so that it shall assist in this dissipation?"

As the electrical energy involved manifests itself on the surface of conductors, the improved rod should be metallic; but, instead of making a large rod, suppose that we make it comparatively small in size, so that the total amount of metal running from the top of the house to some point a little below the foundations shall not exceed one pound. Suppose, again, that we introduce numerous insulating joints in this rod. We shall then have a rod that experience shows will be readily destroyed—will be readily dissipated—when a discharge takes place; and if it will be evident, that, so far as the electrical energy is consumed in doing this, there will be the less to do other damage.

The only point that remains to be proved as to the utility of such a rod is to show that the dissipation of such a conductor does not tend to injure other bodies in its immediate vicinity. On this point I can only say that I have found no case where such a conductor (for instance, a bell wire) has been dissipated, even if resting against a plastered wall, where there has been any material damage done to surrounding objects.

Of course, it is readily understood that such an explosion cannot take place in a confined space without the rupture of the walls (the wire cannot be boarded over); but in every case that I have found recorded this dissipation takes place just as gunpowder burns when spread on a board. The objects against which the conductor rests may be stained, but they are not shattered.

I would therefore make clear this distinction between the action of electrical energy when dissipated on the surface of a large conductor and when dissipated on the surface of a comparatively small or easily dissipated conductor. When dissipated on the surface of a large conductor,—a conductor so strong as to resist the explosive effect,—damage results to objects around. When dissipated on the surface of a small conductor, the conductor goes, but the other objects around are saved

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CONTENTS.

CURRENT NOTES ON ANTHROPOLOGY.—No. XXXVIII. Edited by D. G. Brinton 43

PLEA FOR TEACHING THE HISTORY OF MATHEMATICS. Joseph V. Collins 44

THE KARIFS AND INSULAR CARIBS. John Gifford . 45

PROFESSOR LANGLEY ON THE INTERNAL WORK OF THE WIND. C. F. Amery 46

LETTERS TO THE EDITOR:

A CURIOSITY IN THE VEGETABLE WORLD. T. O. Mabry 47

RED ANTS. W. A. Stearns 47

ON THE COLORATION OF THE RUFFED GROUSE. R. W. Shufeldt 48

LATE-BLOOMING TREES. Willard N. Clute . . 49

POSTAGE ON NATURAL HISTORY SPECIMENS. Philip P. Calvert 49

THE CLIMBING HABITS OF THE SOFT SHELL TURTLE (ASPIDONECTES SPINIFER). Ulysses O. Cox 50

A ROPE OF INSECTS. John B. Smith 50

NOTE ON THE SHOULDER-GIRDLE OF THE MAN-O'-WAR BIRD. R. W. Shufeldt 50

VOLCANIC ROCKS OF THE HURONIAN. George M. Dawson 50

SECRET LANGUAGE OF CHILDREN. H. L. Taylor 50

HABITS OF GRAY SQUIRRELS. D. T. Marshall . 51

SASSAFRAS TREES. N. Hallock 51

A BRILLIANT METEOR. C. H. Ames 52

THE ERILEPIDINÆ. Theo. Gill 52

FUNGI AND INSECTS. Joseph F. James 52

EXPRESSIONS OF EMOTION IN BIRDS' SONG. J. Christian Bay 53

BOOK-REVIEWS 53

NOTES AND NEWS 55

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SCIENCE

NEW YORK, JANUARY 26, 1894.

CURRENT NOTES ON ANTHROPOLOGY.—NO. XXXVIII.

(Edited by D. G. Brinton, M. D., LL. D., D. Sc.)

Origin and Distribution of Maize in America.

THE best study which has yet appeared on maize, both from the botanical, historical and economic points of view, is one recently published in Vol. I. of the "Contributions from the Botanical Laboratory of the University of Pennsylvania," by Dr. John W. Harshberger.

With regard to its origin, he traces it to the highlands of Mexico, somewhat south of the twenty-second degree of north latitude. He believes that from that point it was introduced into the area of the United States from two sources, from the tribes of northern Mexico and from the West India Islands. The Pueblo and northern Mexican tribes derived it from southern Mexico. It penetrated to South America by way of the Isthmus of Panama, whence it extended southward along the great Andean system until it reached the Gran Chaco, where we find the native tribes, no way related to the Kechuas of Peru, borrowing its name, as they doubtless did the cereal itself, from these cultivated people. South American words for maize extended all over the West Indian Islands, showing that it was introduced to this archipelago from the southern continent.

These results are new and most interesting. The statement that the Caribs introduced it into Florida, and that the Antillean word for maize was found in Florida, or in the area of the Gulf States, is an error derived from old authorities whose assertions are now considered unreliable.

The Caribs.

APROPOS of the questions about the Caribs, their original home and their lines of dispersion (see *Science*, Dec. 27, 1893, p. 361), the whole subject is most ably and satisfactorily presented in the recent volume of Dr. Carl von den Steinen, entitled "Unter den Naturvölkern Brasiliens." It is a handsome book, large octavo, with thirty full-page plates, and 160 illustrations in the text, of 562 pages, and containing eleven vocabularies of the native dialects. It is based upon the author's observations and studies in his second expedition to the head waters of the Schingu River, in the years 1887 and 1888.

Besides the narrative of the expedition, the work contains a very complete anthropological description of the native tribes encountered, especially those of the Carib stock. He sets forth their arts, traditions, mental and physical peculiarities, costumes, etc., with desirable fullness. The question of the primitive home of the Caribs is answered by an admirable linguistic analysis of the numerous dialects of the family, and the changes in phonetics and grammatical forms which they underwent in their long separation from the mother tongue. For this the author was peculiarly well prepared by his patient and fruitful investigations of the Bakairi dialect, probably the most primitive in its form of any, reference to which was made in one of my previous notes (*Science*, Aug. 26, 1892).

Those who wish to obtain the latest and the most trustworthy views about the wonderings of these redoubtable warriors should turn to the pages of this valuable book.

Basque and Berber.

THE ethnic relations of the Basques, who now to the number of a scant half million live in the valleys of the Pyrenees, partly in France and partly in Spain, have long been, and continue to be, a difficult puzzle. (See *Science*, July 7, 1893.)

The latest attempt to unravel them is by the Professor G. von der Gabelentz, whose recent loss to science is so regrettable. In an article which was issued in the proceedings of the Prussian Academy of Sciences, in 1893, entitled "Baskish und Berberisch," he institutes a comparison between these two languages and claims to show that Basque is a Hamitic tongue, related to the Berber dialects of north Africa. He believed that this relationship had not heretofore been maintained, which is an error, as so far back as 1876 Dr. Tubino, of Madrid, in his "Aborigines Ibericos," compared the two idioms for the same purpose.

Several of the analogies presented by both these writers are certainly so close and so striking that it seems unreasonable to attribute them to chance; but if they are real, do they establish the claim of a descent of the Basque from the primitive Hamitic stock? No; because they are of such a character that they might well have belonged to the class of loan-words and have been borrowed from the large colony of Berber descent which there are cogent reasons to believe peopled much of the Iberian Peninsula in remote semi-historic times. The modern Basque has borrowed enormously from French and Spanish, and so did ancient Basque from Berber and Celtic dialects.

Micmac Studies.

THE late Rev. Silas T. Rand was for forty years a missionary among the Micmac Indians of Nova Scotia. He was a versatile linguist and acquired a more thorough knowledge of their language, traditions and mode of life than any white man had previously attained. In the later years of his life he compiled an extensive dictionary in two parts, Micmac-English and English-Micmac. The Government of the Dominion undertook its publication, but the author died after the first part only had passed through the press. The second part remains in manuscript in the possession of the Dominion Government, and it is not likely to see the light in print for a long time to come, if ever.

Mr. Rand took especial pleasure in collecting the tales, legends and myths of the tribe from the old men and women who recollected them from a long time back. He

wrote these down word for word from the lips of the narrators in their native tongue, and at his leisure afterwards translated them into English. Some of them were obtained by the distinguished folk-lorist and poet, Charles G. Leland, and published in his "Algonquin Legends." A much larger collection of them, filling a volume of 452 pages, has just appeared in the Wellesley College Philological Publications, entitled "Legends of the Micmacs," with a most satisfactory preface by Miss Helen L. Webster. It is a work the reading of which is both delightful and instructive, and it leads us far into the psychology of these children of nature. The original Micmac of most of these tales is still in existence, and should some day be printed for its linguistic value.

PLEA FOR TEACHING THE HISTORY OF MATHEMATICS.

BY JOSEPH V. COLLINS, PH.D., WOOSTOR, OHIO.

THE time alloted in our schools for the study of political and general history, as is well known, is all too short. Doubtless many teachers on seeing the title above would be disposed to say that it is well enough, but how can the teacher of mathematics find time for it? And, besides, if a little history is a good thing in the mathematics, why would it not be equally desirable in language and science? A fair answer to the latter question presents itself, viz.: Perhaps it would.

It is not surprising that the history of mathematics is neglected in the common schools, because the normal and training schools do not concern themselves with it. The latter have some excuse for this course, since the colleges, from whence they draw their teachers, either pay no attention to it, or only the scantiest, and that indirectly. It is fair to suppose that in a large number of cases the college student of to-day gets his knowledge of Greek mathematics, not from the mathematical department, but out of his Greek studies, and in a crude and confused form. He knows, or, of course, ought to know, that the elementary geometries in use now are merely Euclid's in substance, superior to Euclid's in some ways, but in others less logical. If he were asked to describe the Greek mathematics, or to tell when algebra was first cultivated, it is doubtful whether he could give any satisfactory answer. Indeed, some very interesting statistics could no doubt be secured if these and a few other like questions were put to the seniors in our various colleges. It is doubtful whether the majority would know whether algebra was studied first in the fourth or fourteenth century, or whether trigonometry was cultivated for its own sake at first or as an auxiliary to another science, and if the latter, what science? That effect, whether great or small, the invention of cartesian co-ordinates had on the development of geometry? Whether our present notation in algebra was fixed by a few or by many hands? Or the answers to numerous questions as important as these. Those who had traversed the ground of a good history, besides securing a much clearer comprehension of subjects they had taken years to learn, would have become acquainted with the evolution of a branch of science from humble beginnings and with slow steps, and indirectly would have had a good sidelight thrown on general history.

Even in our universities, if one may judge by the courses set fourth in their catalogues, there is no distinct provision or requirement to secure a knowledge of the history of mathematics, *and so it would seem just to charge neglect of the historical and unifying side of the study of mathematics* all along the line of our educational system. Of course there are exceptions to this. Cajori in his "History and Teaching of Mathematics in the United States" (page 163) says: "One feature of the mathematical instruction at this institution [Princeton] that has been in vogue during the last ten years (perhaps longer) is, we think, to be recommended for more general adoption. Considerable attention is given to the study of the history of mathematics. The writer has before him examination papers, written in answer to questions set by Halsted in 1881. From the answers we infer that questions like these were asked: Who wrote the first algebra that has come down to us? What was its nature? What part did the Hindoos play in the development of algebra? Its growth during the Renaissance? The laws underlying ordinary algebra? etc." The same book gives the following in the mathematical courses in the University of Texas, where Professer Halsted now is: "In the higher classes will be discussed the history and logical structure of the mathematical sciences." Lectures on the history of mathematics are given also at the University of Virginia. No doubt other instances might be found of historical courses offered, but on the whole this is the exception. It seems scarcely necessary to criticise this condition of affairs, as I presume almost anyone would agree that it is unfortunate. It is likely that it is due to the fact that each professor is a specialist and is unwilling to take from his own work the time necessary to prepare such a general course.

The present seems an opportune time to bring forward the claims of this special study, since a new history of mathematics by an American author (Professor Cajori) is soon to appear from the press of Macmillan & Co. So far as the writer knows, it will be the first of its kind to be brought out in this country. It is to be hoped that if the book proves worthy, which it no doubt will, it will have a large sale among college professors, and also among teachers of more elementary mathematics. It will be a mistake for the latter to conclude that they can make no use of such a book. For along with enlarging their views of mathematics, they will find many facts of interest, many old principles new to them, some ideas of prime importance for the proper teaching of scientific geometry, algebra, trigonometry, and analytics, and much material—some stories, perhaps—that may be used to break the monotony of class-room routine. A teacher who does not know what was the controlling idea in the Greek geometry, or one who has never appreciated the difficulty met with in the study of incommensurables, or in attaining a satisfactory theory of parallels, is hardly in position to teach elementary geometry as it should be taught. Many of the results of mathematics, dry and abstract though they may seem from one standpoint, are yet full of interest when viewed as a part of the development of the subject, or when the circumstances under which they were discovered are known. Sometimes a knowledge of the personality of an author of a work, or a demonstration or problem, adds interest to its study. The stories concerning the legend over Plato's door, Archimedes and the Roman soldier, and Newton's apple, are not the only ones that may be related even of these men,—may their shades forgive us for having harped on them so long,—for one and perhaps two of them are apocryphal. But one of the best results of a study of this history by the teachers of elementary mathematics would be the enlarging of their mathematical horizon. Too many even at the present time think that the mathematics that lies beyond a knowledge of the elements of the calculus as set forth in our ordinary college courses is of a transcendental and non-useful character. It is safe to say that by as much as a teacher's vision is widened and clarified, by that much is he made a more intelligent and capable instructor. We enter a plea therefore for a better knowledge of the history of mathematics, hoping thereby to secure a better knowledge and teaching of the subject itself.

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THE KARIFS AND INSULAR CARIBS.

BY JOHN GIFFORD, SWARTHMORE COLLEGE.

THE word "Carib" is very elastic in meaning. It is applied in Spanish America to any wild and savage tribe. Originally it referred only to the natives of the Lesser Antilles and the South American mainland. The words "Carib" and "cannibal" are probably mispronunciations of their proper name *Karina*. The pure Caribs are represented to-day by several tribes in South America and a remnant in the Caribbee Islands. Throughout the American tropics there are Carib mixtures. In Spanish and British Honduras there are many black Caribs. The early Spaniards applied the term *grifos* to the crosses between Negro and Carib, probably because of the frizzled nature of their hair. This word has been frenchified into *griffe* and is now applied also to mulattoes in Louisiana.

In Froude's "English in the West Indies" there are many reckless statements, examples of which are that Pere Labat discovered from the language of the Caribs that they were North American Indians, that they called themselves *Banari*, which means "come from over sea," and that their dialect was almost identical with what he had heard in Florida. There seems to be little foundation for this statement. There are reasons for believing that the Caribs of the Lesser Antilles migrated from northern Venezuela and that they spoke a dialect of the language of the mainland Caribs.

According to the Spaniards the Caribs of old were exceedingly fierce and corrupt, but these statements, as well as others concerning their language, are controverted. Dr. Wilson calls them the "historic race" of the Antilles, and Peschel speaks of them as an "extraordinarily gifted race, both physically and intellectually, whom we must not condemn too severely for their complete nudity, their inclination to piracy, their craving after human flesh and the poisoning of their arrows." Some of the highest and some of the lowest specimens of South American Indians are Caribs.

The mainland and probably also the insular Caribs poisoned their arrows with curare, the juice of *Strychnos toxifera*, a climbing plant of Equatorial America. The arrows were light and were blown through a tube in a manner similar to the Dyaks of Borneo. This tube was made from the stems of *Arundinaria Schomburgkii*, a plant of the grass family resembling bamboo. This plant was named in honor of Schomburgk, a famous German traveller, sent in 1835 to explore Guiana by the Geographical Society of London. Among his many interesting finds was the *Victoria regia*. He had opportunity to witness the effect of their poisoned arrows and is charged with the statement that a deer at the top of its speed when hit with such a dart drops dead at the end of forty yards.

In what follows the writer only refers to the insular Caribs and the Karifs or black Caribs on the coast of the Bay of Honduras.

St. Vincent and Dominica were the principal rendezvous of the insular Caribs, although they occupied all the islands of that beautiful chain extending from Puerto Rico to the mouths of the Orinoco and raided at times Jamaica and San Domingo.

Many and bloody were the wars which the Caribs fought with the early colonists. In spite of their endurance they were unable to withstand the superior force and diseases of the Europeans, and all that is left in the Lesser Antilles is a little colony on the Island of St. Vincent.

In an old book on the "Caribby" Islands, the aborigines are described as good-looking, well-proportioned people of medium size, with mouths not overly large; teeth, close and white; complexion, orange; beards, scanty; hair long and black, and eyes black, piercing and somewhat Mongolian. This description fairly applies to the yellow Caribs still living on the Island of St. Vincent.

The original Carib looked very fierce because he wore no clothing, and dyed his body with arnotto (*Bixa Orellana*). It was called *roucou*, and in French Guiana there is a low tribe of Caribs called the *Roucouyennes*.

The Caribs of to-day are very able watermen. The boys even while very young are of an amphibious nature. They can catch a three-pence before it strikes the bottom of the bay, and think nothing of putting to sea on a fishing expedition on two logs nailed together. Even the women of the Black Caribs of Honduras bring bananas in small piroques to the ships in rough weather. They inherit this from their forefathers. The word "canoe," it is said, is of Carib origin. They were probably the first Indians to invent the sail. When the wind was fair they spread a cotton cloth; at other times it is said they rowed their canoes with oars, and even sang a song in time to the stroke, as sailors do to-day. Their piroques-of-war were often forty feet in length by six in width. Boats of almost this size, hewn from a single log, may be seen to-day in British Honduras. The trunks of the Giant Ceiba (*Bornbax Ceiba*) were used for this purpose. It is said that the word "ceiba" is a Spanish corruption of an Indian word for boat. The tree is of enormous size, but the wood is soft and not durable. It is also the Sacred God Tree of the Negroes.

Carib relics are often found. A collection was on exhibition at the Fair in Jamaica. They deftly fashioned implements and utensils from stone, bone and shell. There are two rocks in Grenada on which quaint hieroglyphics are cut. There too is the "hill of the leapers," where a hard-pressed, ill-fated band of Indians plunged into the sea. Many interesting remains were found on the Island of Amba, and these were of such superior workmanship that they reminded the discoverers of Greek patterns.

At the Jamaica Exhibition in 1891 there were six Caribs sent by the Government of St. Vincent. Three of these were types of "yellow" and three of "black" Caribs. They were engaged in basket making in the Industrial Village. At this work they are very skilful, the baskets they weave being water-tight.

The yellow Caribs form the purest remnant of the aborigines of the Lesser Antilles. The black Caribs

partake more of the characteristics of the Negro than Indian. Besides weaving baskets and fishing they raise patches of yams, casava, bananas and the like. A few fled to Trinidad when the volcano Sonfriere erupted.

The black Caribs, it is said, originated in this way: A slave ship was wrecked on the Island of Bequia. Those who escaped, together with other runaway slaves, captured Indian wives. Their progeny is the so-called "black Carib." They increased rapidly, became troublesome and finally occasioned much bloodshed. In character they were not unlike the Jamaica Maroons, the offspring of runaway slaves, who have lived for many years in the secluded valleys of that rugged island.

In October, 1776, the last Carib war was fought. Five thousand and eighty men, women and children were removed to the Island of Balliceaux from St. Vincent. The following year they were shipped to the Spanish main, but owing to revolutions, having had enough of wars and quarrels, many drifted to the coast of British Honduras to seek peace and protection under their former masters, the British.

In Balize they call themselves "Karifs." Such a name serves well to distinguish them from the Caribs of pure Indian blood.

During the past winter the writer came much in contact with the Karifs on the coast of Honduras. He left the beautiful Island of Cozumal, famous for its healthfulness and its fine-flavored tobacco, and coasted for several days along Yucutan and Honduras. The only boats passed were fruiters, fishermen carrying their catch alive in tanks to Havana, and a Norwegian bark with a load of mahogany. One looks longingly toward the site of ancient Tuloom and pictures in his mind what ruined cities may be hid in the forests of that unexplored wilderness. Although these waters are of much interest and beauty, one is menaced by constant danger, since to be cast on the reefs on one side means certain destruction, or to be washed on the sandy shore of Yucutan on the other is to fall into the hands of very hostile Indians. One draws a freer breath when he reaches the coast of Honduras. It was Christmas night when the writer arrived at Belize, the capital.

The mahogany cutters in large numbers came in from the forests, and the Karifs from the neighboring coast villages paddled into town in their light piroques. The array of color in this collection of types and rabble of merry-making people was dazzling. The moonlit streets resounded with the cries of drunken woodmen. Gaily dressed musicians marched up and down, followed by a horde of merry men and women and half-dressed children. The players rattled the loose teeth in the jaw-bone of a donkey, rubbed a piece of tin over an old cassava grater, played home-made guitars, rattled bones and beat tam-tams. Many were singing a strange melody to the tune, half humming, half pronouncing words in an unintelligible patois and keeping time by wiggling their bodies.

The festivities over, the Karifs left for their homes, and the city resumed its usual peaceful silence.

In British Honduras there are about 32,000 people; 14,000 of these constitute the Spanish element (that is, Spanish and Indian and pure Indian); there are about the same number of negroes and mulattoes; 3,000 Karifs; and 1,000 Europeans and others. The coast is mainly inhabited, the interior being mostly an unexplored wilderness.

The colored population (that is, negroes and mulattoes excluding the Karifs) are very influential citizens in Belize. Many own considerable property and marry whites. They are called Creoles, which wounds the pride of the Louisiana Creoles, since they profess to be of pure French or Spanish extraction.

The Karifs live in huts made of pimento slats covered with mud and thatched with the leaves of the Cohune palm. They hunt, fish and grow cassava, yams and maize. They also raise cocoanuts and bananas, which they sell to fruiters.

The women wear nothing but a loose, sleeveless chemise of white cotton, which reaches to their knees, and a kerchief picturesquely tied around the head. The men wear a cotton shirt, pants and straw hat.

Under the refining influence of English rule, with schools, churches, hospitals, and especially the absence of American missionaries and color prejudice, they are rapidly improving.

PROFESSOR LANGLEY ON THE INTERNAL WORK OF THE WIND.

BY C. F. AMERY, CLINTON HALL, NEW YORK CITY.

In the current number of the *American Journal of Science* there is a paper by Professor Langley, entitled "The Internal Work of the Wind," in which he gives the results of some very interesting observations on the extreme fluctuation in the horizontal speed of the wind as recorded on a light anemometer, at intervals, not of minutes, but of a few seconds only. He finds, for instance, that a conventional twenty-mile-an-hour wind will continually range from ten to thirty-miles an hour, at intervals of twenty seconds, occasionally rising to thirty-five miles an hour, or falling to a momentary lull. From these unexpected facts the Professor argues for such a necessary turmoil in the atmosphere as appears to him to furnish the factor necessary to afford an intelligible explanation of the otherwise apparently inexplicable problem of a heavy body, like a vulture, circling for hours aloft, without wing-motion or apparent effort of any kind. Further, the Professor regards this "internal force" of the atmosphere as a factor of so much importance in aeronautics that he ventures the prediction that the aerodrome of the future, by the mere change of the inclinations or aspects which it presents to the wind, will be able to achieve long journeys, even to circumnavigate the globe, with the expenditure of no more energy than is required for the necessary adjustment of its inclinations to the changes of the medium it floats in, except during calms.

Anything published by Professor Langley as the result of his careful deliberation is entitled to respectful consideration, but in the present instance I venture the assertion that he is being led away by a fallacy from his true line of investigation of this very interesting problem. His point of departure is, I think, easily traceable to a sentence embodying the expression that it would be impossible for a bird to circle in the effortless manner exhibited by a vulture under his notice, if the winds had been mere horizontal currents. This is an unsupported, and I believe it is a mistaken assumption; but leaving this for the present, I will first deal with what I consider the mechanical heresy involved in his prediction of the capabilities of the aerodrome of the future. Direct onward flight and circling involve some differences of mechanical principle. The eagle can circle upward with rigidly extended wings, but in essaying an onward course under the same conditions he must descend.

The mechanical principle of bird-sailing, that is, of gliding down an incline, may be expressed as the translation of the force of gravity into horizontal flight, by the pressure of a column of air on the under surface of the bird or artificial aeroplane presented to it at a suitable angle. The weight, with the first fall from a state of rest, gives the impulse, and the maintenance of the due angle, the direc-

tion. If at any point of its course the bird readjusts his position so as to present the full area of his wings to the line of flight, he will shoot upward, still with motionless wings, to a height of some feet, but never to the height from which he descended. I have seen an eagle at the end of a half-mile sail, glide upward ten or fifteen feet to his objective point, and I think this is about the limit he can attain without beating his wings.

Now with the aerodrome of Professor Langley's dream, it, with an initial impulse, it could be maintained on a horizontal, forward, course by adjustments of its inclinations to the internal working of the column of air over which it is passing, its force of gravity would be immediately neutralized, and its onward flight consequently arrested. A plane body many times heavier than air cannot be sustained in direct horizontal flight through the air, except by an expenditure of internal energy sufficient to propel it with a speed proportionate to the requirements of its specific gravity, qualified by its surface area.

Professor Langley will not have failed to observe, or the mention of the fact will recall it to his recollection, that sailing-birds pursuing an onward course do not maintain a horizontal line by availing themselves of any internal motion in the air, but simply by their own unaided physical energies.

Recurring now to the less clearly apprehended problem of circling, I believe that Professor Langley's argument that the bird could not circle with motionless wings in a horizontal current, requires one important qualification—he should have added "at least not if he carries his own wings level with the horizon." This the circling bird never does. He could no more circle while he did so, than a bicyclist could circle on an upright wheel. But by holding his wings obliquely to the horizontal circle of his flight, he can utilize the wind as a lifting power for about five-eighths of his course, and for propulsion also over nearly the same length, provided the wind blows faster than he flies. This is precisely on the principle on which a perforated card or messenger screws its course up the string of a kite. The wind blows horizontally but strikes the messenger obliquely. If the bird describes an oval, facing the wind only on the short course, he may utilize the wind for driving, over three-fourths of the course or even more. There is hence at every sweep an accumulation of impulse to urge it over the difficulty of sailing against the wind. At that stage, the bird can most easily adjust his wings, so as to make the opposing air lift him ; the effort is required only to force himself into the wind's eye. By gliding slightly downward over the one-half or more of the course, with the wind, he acquires an impulse from the joint action of wind and gravity, almost, or quite sufficient, to drive him over the remainder of the course, and to raise him to his original level while facing the wind. If the impulse is not strong enough, the effect will be seen, not necessarily in the bird falling to a lower level, but in his circling further and further to leeward at every sweep. In fact the aerodrome of the future, although, like the bird, it may not sail a straight horizontal course without an expenditure of energy, may nevertheless, like the bird, be maintained in circling flight, in a moderate breeze, indefinitely, with a minimal expenditure of energy, not in consequence of the "internal work" of the air, but in spite of it. But while this explanation of the mechanics of circling flight renders it conceivable that, given the initial impulse, it can be accomplished in a moderate breeze without any expenditure of energy, beyond what is required for constant readjustment of the inclination of the plane, I am by no means certain that, in the case of the bird, the tail is not an important adjunct in propulsion. This obliquity of the direction of the wings to the horizon of flight is the clue to the whole mystery of circling or soaring flight.

The clue being given, the following propositions will, I think, serve to completely unravel it :

First. A bird gliding down an inclined plane owes his forward flight to the force of gravity.

Second. To maintain himself in horizontal flight, whether in a direct line or in a circle, power is necessary, first to overcome the force of gravity, second to propel him on his course.

Third. The bird flying in a direct line provides both lifting and driving power by beating his wings, as the boatman uses his oars ; the circling bird achieves the same ends by trimming his wings to the wind, as the sailor trims his sails. Professor Langley suggested the solution when he argued that the power must come from the air.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as a proof of good faith.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The Editor will be glad to publish any queries consonant with the character of the journal.

A Curiosity in the Vegetable World.

NEAR a country roadside in Tate County, Miss., is a curiosity which is of interest to every passer-by, but is especially interesting to a student of nature.

All of us, doubtless, have observed "twin" or "double" trees, which have a common stock for some distance above ground, and which might be accounted for by the cessation of growth of the terminal bud of the trunk, and by the upward development of two branches from lateral buds. But the phenomenon I speak of is this : two large elm trees (*Ulmus Americana*) about 1/2 and 2 feet in diameter, respectively, have crossed each other, and have grown together, in this wise. The trees are about 8 feet apart at the base, and one crosses the other about 6 feet from the ground, the trees and the ground between forming a right-angled triangle ; rather an obtuse-angled triangle ; for the tree which is most nearly erect is inclined slightly in the direction in which the other lies. It seems that when young, or at least some years ago, one of the trees was blown up against the other, the two uniting where they crossed as solidly as if one were a branch of the other, the one growing almost upright, while the other continued its growth in a nearly horizontal direction.

The latter is, I should say, about 50 feet long, and the upper end of its trunk about 15 feet from the ground.

T. O. MABRY.

University of Mississippi, Jan. 23, 1894.

Red Ants.

A SHORT time since I read an article in *Science* concerning red ants. I wish *somebody* could tell me how to rid a building of them.

Upon our grounds are two buildings, hardly fifty rods apart, the "South Hall" being infested from garret to cellar and the "North Hall" being absolutely free from them. I can find no great difference of soil or position to account for this. Why the one building should be so infested with them and the other *not* is more than I can explain. I have tried almost every known remedy against them without success.

For weeks, even months, our rooms will be apparently clean and free from these pests. Let me bring a piece of meat on a plate into the room, set it anywhere I choose, and within twenty-four hours there will be hundreds,—if it remain over night thousands,—literally, of them covering it and the neighboring ob-

jects. I have held plates over the lamp or stove and burned them by the thousands, yet in twenty-four hours as many more would appear. Where do they come from? Leave them alone, and they will eat the refuse and disappear as mysteriously as they came. A dead bird, animal, or glass in which there has been sugar; a piece of cake or bread, even—it is just the same.

I have made some interesting observations in watching these small, apparently insignificant animals. They march in long slender lines and with the regularity of clock work. I have dropped a small crust of moist bread in the centre of a room and of a tapestry carpet, and in half a day or less found it one living, red mass of these small red ants. They seem to be everywhere. I believe they have regular scouts, always roving about, seeking food.

An ant that has found a bit of food will turn and retrace his steps until he finds a companion, they will put their heads and their antennæ, or both, together, touching each other a number of times, as if really in communication with one another (as I do not doubt they are), when the first ant will return to the food, and the one bearing the message will rove round until *he* can communicate with another ant, when *he* will return, likewise, to the same food. And so it goes on. It seems to be necessary that each communicate with some other before he can take his course to where the food is. So each communicates with another or some others. I have, in this way, seen a single ant turn the course of a procession of five hundred and over.

I have had much amusement in keeping these ants from the table of a sick person, upon which were an assortment of provisions. First the ants crawled up the legs of the table,—then I tied papers of naphthaline around the legs. This kept them off for awhile, but they soon walked fearless over the naphthaline and were up the table again. Old lemon did no good, various kinds of "sure cure" did no good; finally I cut four squares of sticky fly paper, a foot square, and put a piece under each leg. The ants came up to it, walked all around it, tried it in various places and then backed out. They would daintily step here and there upon it, feeling all about with their antennæ, and retreat again. About a dozen, and no more, lost their lives by venturing on it. But let the dust collect or the paper bend or break, and in less than half an hour the table was alive with them. They appeared in a procession orderly, and, when the food was gone, disappeared in a procession orderly. They often come from the least crack in the wall or floor in the centre of a room,—whether they crawl around the room, in and out of the chinks, or come directly from the walls in which they live, I cannot tell. I once had a nest of them between the leaves of a book catalogue in the interior of my writing secretary. When and how they came there I do not know. I could, doubtless, fill a whole issue of *Science* with the results of my watching of these interesting scavengers, for they are nothing else, but space forbids. I have had them *all over the body of a sick person*, without any attempt to bite the person and only intent upon eating or carrying away crumbs of bread left there and in the immediate vicinity. I have put food in various situations for them and watched them find it. Some kinds of food they do not touch, apparently; others they are greedy for and swarm to. Is it possible to clear the building of these pests? I call them pests, as they are so active, so abundant, and will not let food placed for others, and not for them, alone.

W. A. Stearns.

Atlanta University, Atlanta, Ga.

On the Coloration of the Ruffed Grouse.

One is rather left to suppose that Mr. J. H. Bowles believes from what he says in his article of the above title (*Science*, No. 571, p. 16) that the Eastern forms of *Bonasa* exhibit a dichromatism of plumage such as we find in the screech owls of the genus *Megascops*. This is the more likely to be so from the fact that he nowhere has stated in his article that ornithologists recognize at least two forms of *Bonasa* in New England. He simply explains his "meaning by selecting three birds from a bag taken in this vicinity (Ponkapog, Mass.), as they show to perfection the three different phases seen in this species, viz.: gray, brown or red, and intermediate." Now *Bonasa* in the matter of plumage is *not* dichromatic as is *Megascops*, but two of the forms described by Mr. Bowles are either well-recognized species or sub-species of ruffed grouse.

In his "Manual of North American Birds" Mr. Ridgway gives us the following representatives of this genus, viz.: *Bonasa umbellus*, *B. u. umbelloides*, *B. u. togata* and *B. u. sabini*. Of these I compare *Bonasa umbellus* and *Bonasa umbellus togata* with Mr. Bowles's specimens.

Mr. Ridgway.	Mr. Bowles.
B. umbellus.	
a[1]. Paler, with brown markings on lower parts rather indistinct (except on flanks), and more or less concealed on breast and belly by broad whitish tips to the feathers, these brown markings usually without distinct edges; bars on flanks usually clear; hair, brown.	
b[1]. (*B. umbellus.*) Upper parts mostly or entirely rusty, the tail usually rusty ochraceous. Hab., eastern United States, west to edge of Great Plains (?), north to Massachusetts (lowlands), south to Georgia (uplands), Tennessee, Arkansas, etc.	("The Southern form.") The phase found in the southern portions. Its fan is of a decided rufous tint, appearing in no way like that of the northern bird, except for proportions, and the transverse black bands. (These bands are always black, having a decided tinge of rufous in but *very* few cases). The tail coverts and upper parts are also of a reddish tint, the ruffs being a strong brownish red, tipped with dark brown and tinged with iridescent brown."
Bonasa u. togata.	
a[2]. Darker, with brown markings on lower parts very conspicuous, everywhere exposed and bordered by very distinct dusky bars; bars on flanks very dark brown or brownish black.	
b[1]. (*B. u. togata.*) Upper parts with more or less gray, often mostly grayish, the tail usually gray (sometimes tinged with ochraceous). Hab., eastern Oregon and Washington Territory, east to Moose Factory, Nova Scotia, Maine, etc., southward on mountains of New England, New York, etc.	("The Northern form.") "Taking the one in the gray plumage, which is the type found most commonly in Maine and the other northern parts, the fan of long tail-feathers is of a decided grayish cast, the back, upper and lower tail coverts being of the same shade. (The tail coverts and back vary in intensity to a greater or less extent in individuals). The ruffs are black throughout, with a strong tinge of iridescent green."

Of these two forms Mr. Bowles simply remarks "All things considered, the northern and the southern bird, when laid side by side, would hardly be taken for the same species." Mr. Bowles's third or intermediate form is accounted for by Bendine, in his handsome work upon "Life Histories of North American Birds," where he says: "In the New England States north of Massachusetts it (*Bonasa umbellus*) intergrades with *B. umbellus togata*, the majority of the specimens found throughout southern Maine, New Hampshire, Vermont and northern New York being scarcely referable to either form, birds found in the high lands approaching the Canadian ruffed grouse, while those in the valleys are nearer typical *Bonasa umbellus*."

The charge of Mr. Bowles that "comparatively little has been *printed* concerning the variety of colors worn by the ruffed grouse (*Bonasa umbellus*),—which seems surprising, as it is a favorite game bird,"—can hardly be sustained. It would have been better had your contributor consulted the *very extensive* literature upon this genus before he undertook to *print* his article in *Science* on the coloration of the bird. R. W. SHUFELDT.

Takoma, D. C., Jan. 23, 1894.

Late-blooming Trees.

THE remarks in a recent issue of *Science* on fruit-trees blooming in autumn are of much interest in that connection, but when it is found that many of our wild-flowers show a tendency to bloom at this season, the causes suggested seem hardly sufficient to explain the phenomenon. Some plants that bloom in spring habitually bloom again in September or October. In this class are the common blue violet (*V. palmata* var. *cucullata*) and the dog violet (*V. canina* var. *mulenbergii*). Specimens of these may be found in bloom every autumn, and often the arrow-leaved and Canada violets as well. It is not uncommon to find the red raspberry producing flowers and ripe fruit as late as the middle of October in this latitude. Among the twenty-two species of spring flowers that I have found blooming in late autumn may be mentioned *Hepatica triloba*, *Epigaea repens*, *Houstonia caerulea*, *Ranunculus fascicularis*, *Rosa blanda*, *Hieracium venosum* and *Potentilla canadensis*. When the whole list is examined it will be found that this trait of blooming twice runs through certain floral orders. The rose family (to which the fruit trees belong) is easily first, followed by violets, crowfoots, etc. The list contains few, if any, representatives of those plants that spring from bulbs, corms, or thickened rootstocks, although their buds are formed in autumn. Having a stock of food to draw upon, it would seem that these should be the first to respond to warmth and moisture. It appears to be quite rare for the trillium, dog-tooth violet, spring beauty, rue anemone or blood-root to bloom in autumn, and I should be pleased to hear from those who have found them in blossom at that season.

Apropos of this subject it may be mentioned that the blooming of plants out of season has long been considered an unlucky omen. An old saw runs, "When roses and violets flourish in autumn it is a sign of plague or pestilence during the coming year." In certain parts of the United States the blooming of fruit trees in autumn is supposed to be the precursor of a death in the owner's family. WILLARD N. CLUTE.

Binghamton, N. Y., Jan. 19, 1894.

—Mr. A. C. Cowley, of Trinity College, Oxford, and Mr. T. G. Stenning, Magdalen College, Oxford, have just left for St. Catherine's Convent, Mount Sinai, in order to continue the investigations begun by Mrs. Lewis and Prof. Rendel Harris.

Postage on Natural History Specimens.

IN *Science* for Nov. 17, 1893, p. 267, appeared a circular issued by the Academy of Natural Sciences of Philadelphia, concerning the transmission of specimens of natural history by mail between different countries. This circular asked scientific bodies in certain countries therein named to request their respective governments to favorably reconsider a proposition, made by the United States Post Office, to admit such specimens to the international mails under the rates for "samples of merchandise," this proposition having been once rejected by those countries.

In *Science* for Dec. 22, 1893, p. 348, a Canadian correspondent, Mr. W. Hague Harrington, criticises this circular as follows: "It is sought to throw the blame upon the countries in question, whereas the trouble arises solely from the fact that the United States have not yet advanced far enough to have a *parcel post*, as is in operation among these other countries. There is no difficulty in transmitting specimens from Canada to the most remote countries, but the United States by their policy make it impossible to receive or to send them. The scientific societies should exert their influence at home, and endeavor to have the United States Congress adopt the more advanced and liberal postal arrangements of the countries which your correspondents blame for their troubles."

As chairman of the committee appointed by the Academy to prepare the circular, I have obtained from Mr. N. M. Brooks, Superintendent of Foreign Mails, U. S. P. O., the following official information, which, it is believed, will sufficiently justify the means adopted by this Academy to secure the end desired. It gives me great pleasure to acknowledge here the unfailing courtesy of Mr. Brooks throughout our correspondence on this subject.

The Superintendent's letter, dated Jan. 12, 1894, reads: "With respect to the criticisms (quoted in your letter under reply) upon this Department's failure to more generally establish the parcels post service, it may be well to say that so far as *small packages* of natural history specimens are concerned, the parcel post would afford but few additional facilities over those offered in the regular mails if the rates were assimilated to those in force in Great Britain and Canada; for instance, the lowest charge in Great Britain on a package weighing 3 pounds *or less* addressed for delivery in Belgium is 1 shilling 3 pence (=30 cents), and to France 1 shilling 4 pence (=32 cents), while in Canada the charges for a pound *or less* would be to Belgium 46 cents, and to France 48 cents. While the sums named above may be low for the transmission of three-pound or one-pound packages, it must be remembered that these sums are the minimum charges and must be paid also on smaller packages, even on packages weighing only one or two ounces. If the proposition of this Department, to admit natural history specimens to the mails as 'samples,' had been adopted, small packages of such specimens would have been transmissible throughout the extent of the postal union at the rate of one cent for each two ounces, while the facilities offered by the parcels post for the transmission of larger packages would not have been curtailed. For example, under present conditions a package weighing 4 1/2 ounces may be sent from Canada to Belgium or France as *a letter* upon the prepayment of 45 cents; as a parcels post package the charge would be 46 and 48 cents, respectively; as a 'sample' the charge would be 3 cents."

It may also be mentioned that the United States *have* a parcels post to certain American countries at the rate of 12 cents per pound or fraction of a pound.

Mr. Harrington's criticism is inaccurate when he says that this Academy's circular "suggested that the various scientific bodies of the United States should use their influence to induce the governments of certain enumerated

countries to consent to such material passing by sample post." The circular, on the contrary, stated that this Academy had "resolved to address the various scientific bodies, with which it is in communication *in those countries whose governments have voted against the proposition*," and it is these societies only which the Academy has addressed on the subject. PHILIP P. CALVERT.

Philadelphia, Jan. 13, 1894.

The Climbing Habits of the Soft Shell Turtle (Aspidonectes spinifer).

WHILE making observations on Mud Creek at Ravenna, Nebraska, in the interests of the U. S. Fish Commission last August, I chanced upon an interesting sight. A dam extended across the creek which had been constructed of two-inch plank placed side by side, but instead of placing the edges all in the same vertical line the plank above had been drawn back a little each time, so that the dam presented a series of very narrow steps leading up stream. The slope was gradual, except the last two planks at the top, whose edges were placed in the same vertical line, thus making here a step of four inches instead of two, and, more than that, this four-inch step was allowed to extend out over the one just beneath it for a short distance. The dam was about twelve feet high, and the angle was enough to place the top of the dam two feet farther up the stream than the base. As I approached from below my attention was called to a soft-shelled turtle that was protruding his head from the water at the base of the dam. I did not think that such a clumsy animal would attempt a climb of twelve feet on a very poor road, but presently he ventured out, and by careful feeling was soon up two feet, but at the next step he tumbled back into the water. He was no more down when he started again, only to receive another tumble. Several times this occured, but the last time he had reached the last step, when he met the projecting four-inch step. It was too bad to see him tumble after so much hard work, but the last projection was too much for him, and down he fell twelve feet into the water. He seemed discouraged and not inclined to try it again, although I watched for some time to see what he would do. In addition to the steepness of the steps there were little streams of water flowing over here and there, some of which struck the turtle as it was climbing up.

I saw a common snapping turtle (*Chelydia serpentina*) at the foot of the dam, and while it would thrust out its head and look longingly above it did not attempt to climb.

ULYSSES O. COX.

Mankato, Minn.

A Rope of Insects.

IN response to the letter of Mr. Lynds Jones in *Science*, Dec. 29, I quote the following, concerning the family *Mycetophilidae* from the Standard Natural History, II., 408: "The larvae of one genus, at least (*Sciara*), have long been known for their gregarious habits. They are often found in dense patches under the bark of trees and, what is more interesting, when about to change to the pupa state, will congregate in immense numbers, forming processions that have been observed four or five inches wide and ten or twelve feet long. They travel in a solid column from four to six deep, over each other, advancing about an inch a minute. From this peculiar habit, they have been called the army-worm in Europe. Similar habits have been observed in this country among our species. One species of this genus (*S. mali*) is known to feed in numbers in the interior of apples in this country." This peculiar habit will be found commented upon in many other popular works on insects. JOHN B. SMITH.

Rutgers College, New Brunswick, N. J.

Note on the Shoulder-Girdle of the Man-o'-War Bird.

FOR publication in another connection, I have recently written out a complete account of the skeleton of the man-o'-war bird (*Fregata aquila*), and have been interested in what my friend Professor Alfred Newton, F.R.S., says of its shoulder-girdle in the "Dictionary of Birds," now passing through the press. In the work named, Professor Newton remarks: "In one very remarkable way the osteology of *Fregata* differs from that of all other birds known. The furcula coalesces firmly at its symphysis with the carina of the sternum, and also with the coracoids at the upper extremity of each of its rami, the anterior end of each coracoid coalescing also with the proximal end of the scapula. Thus the only articulations in the whole sternal apparatus are where the coracoids meet the sternum, and the consequence is a bony framework which would be perfectly rigid did not the flexibility of the rami of the furcula permit a limited amount of motion." (Part I., pp. 293, 294.)

At this writing I have at hand a very perfect skeleton of *Fregata*, kindly loaned me by the United States National Museum, and in it the scapulæ are perfectly free and articulate, as usual with the coracoids, and it is only the furcula that fuses with the coracoids above and with the sternal keel below. Knowing what an accurate observer and describer Professor Newton is, I repaired to the National Museum, and through the kindness of Mr. Lucas, the curator of the Department of Comparative Anatomy in that institution, I was shown the shoulder-girdles and sterna of a number of specimens of *Fregata*, but in each and all of them the scapulæ freely articulated with the coracoids in a manner common to the class Aves. We must believe then that when Professor Newton wrote out his description of that part of the skeleton of the species in question, he must have had before him an abnormal example of the bones to which we refer. My work when published will give a very full and accurate description of all the bones in the skeleton of this very remarkable species, comparing them with the corresponding bones represented by an unusually fine series of the skeletons of other *Stegarcopodes*. R. W. SHUFELDT.

Takoma, D. C., Jan. 19, 1894.

Volcanic Rocks of the Huronian.

IN Mr. U. S. Grant's interesting note on volcanic rocks in the Keewatin of Minnesota, which appeared in *Science* of Jan. 12, he writes: "That the Keewatin rocks northwest of Lake Superior are to a considerable extent composed of volcanic (effusive) material has been stated already by G. M. Dawson, A. C. Lawson and N. H. Winchell." It will be found, however, on referring to the descriptions above cited, that a large part of the formation as it occurs in the vicinity of the Lake of the Woods is actually composed of volcanic breccias and volcanic ash rocks, though materials of effusive origin are also abundant.

The breccias or agglomerates are often very coarse, and the circumstances are such as to indicate that there must have been several volcanic vents even in this region. See "Geology and Resources of the Region in the Vicinity of the Forty-ninth Parallel" (1875) pp. 51–52; *Geological Magazine*, Dec. 11, Vol. IV. (1877), p. 316; "Annual Report of the Geological Survey of Canada" (1885), pp. 49CC. *et seq.* GEORGE M. DAWSON.

Geological Survey of Canada, Jan. 24, 1894.

Secret Language of Children.

A CURIOUS instance of child language, different from any mentioned by Mr. Chrisman in a recent issue of *Science*, has come under my own observation. It was

invented and used by my brother-in-law, Mr. Philip E. Brodt, now a student in Columbia College, when he was about five years of age and living in Dansville, N. Y. While several of the ordinary forms of secret language were known to the children of that town, this language, so far as is known, was a pure invention of Philip, devised probably for his own amusement. No one spoke it but himself, though other members of the family learned to understand it. The boy spoke ordinary English like the other children, and when five years old he spoke fluently this language in addition, when it pleased him to do so. Mr. Brodt still remembers the language, and has kindly transcribed in English and his own language some verses which he was in the habit of repeating at that time.

Hillie wad pa urpmle onkey
Climbup ing ye allsto wick;
Sen he whucked pe thaint aff oll
Mit ade dim heathsi lyck.
En whin dys hiing clour he hasped
Me thonkey in hand his
Band ade warefell wo tearth frand iends
Wand ent tino ba ettler and.
Mo nore she'll hoot lis hittsle ister
Ith whis guden woon,
Mo nore pe'll hull ke thittty's ail
Mand ake yer howl fun for.
Ke thittty's ail stow nands strup aight
Ge thun lis aid saïde,
Me thonky cloes not dimb mo such
Lince sittle Dillwie ied.

Willie had a purple monkey
Climbing up a yellow stick;
When he sucked the paint all off
It made him deathly sick.
When in his dying hour he clasped
The monkey in his hand
And bade farewell to earth and friends
And went into a better land.
No more he'll shoot his little sister
With his wooden gun,
No more he'll pull the kitty's tail
And make her yowl for fun.
The kitty's tail now stands up straight,
The gun is laid aside,
The monkey does not climb so much
Since little Willie died.

While the verses have the appearance and sound of gibberish, it will be seen that the modified words are formed from those in the original by simple transpositions of the consonantal sounds beginning adjoining words or syllables, and sometimes of similar vowel or syllabic interchange, with a few minor modifications apparently for euphony.

H. L. Taylor.

New York.

Habits of Gray Squirrels.

I was much interested in reading the article by Ray Greene Huling in *Science* of Dec. 1 because it gives positive testimony to what I have always believed in regard to the habit of parent gray squirrels taking their young to places of safety. Some years ago I and my companions had a mania for raising young gray squrrels. In our hunts in the woods we found that not more than one good nest out of five contained any young, and that if we did not secure the young when first found they were always gone when we came again. We explained the great numbers of empty nests by saying that they were to put the young in when the home nest was discovered.

I have raised several young gray squirrels. They were taken from the nest when they were still blind and their tails had not yet become bushy. I fed them with milk by means of a glass pipette, holding one end in my mouth to regulate the flow. I found this apparatus much more satisfactory than spoons or bottles with perforated corks and quills.

The habits of one of my pets in particular were instructive. This squrriel was taken from the nest in the fall, and after having learned to eat solid food was allowed to run at large in the house most of the time during the winter, often being carried for hours in the pockets of some member of the family. In the spring when the doors and windows were open the squirrel was allowed to run about the place. In the course of a month or so he had built *six* different nests in as many different trees and vines around the place—one in the honeysuckle on the front piazza, one in the Virginia creeper that covers one side of the house, and the others in the spruce trees on the lawn. During all this time he was tame enough to be coaxed into the hands by the offer of nuts, etc. As the weather grew warmer our pet became quite a nuisance from his habit of carrying off handkerchiefs and lawn neckties with which to line his numerous houses, and from his making a store-house of the bedroom next his nest, on one occasion actually storing a lot of nuts between the sheets of the bed.

For two or three days we noticed that our pet was making a very peculiar noise, something like a scold, but yet not a scold, and that at the same time he (or she) seemed very restless.

At the end of that time he disappeared, and as our neighbors, who lived near a grove about half a mile from us, reported seeing a squirrel which came close to them to be fed, we had no doubt it was ours, which had gone to the grove in search of a mate.

In robbing the nest of the gray squirrel I do not remember to have seen the old squirrels in or near the nest when I had climbed up to it. My experience with the flying squirrel was different. I frightened an old flying squirrel from her nest and while feeling in the nest for the young, the old one actually came back to the nest, and on my climbing away from the nest she entered. This was repeated three times. I finally put the nest in my soft felt hat, and when the mother went in I closed it up and took her and the three young ones to my house. The young were afterward drowned by the upsetting of a cup of water in their cage, but not until after the mother had nursed them for three days in their captivity. I afterward got three more young flying squirrels and raised them on milk. When grown they were very tame and affectionate, but were not as lively and playful as the young grays.

D. T. Marshall.

Metuchen, N. J., Dec. 14, 1893.

Sassafras Trees.

I was much interested and rather amused by a letter in *Science*, Jan. 5, from W. J. Quick, on the sassafras, in which he says that "it almost attains the dignity of a tree in size."

I should like him to see some specimens on Long Island, although they are, as well as all large trees, fast disappearing so near New York.

When I first came here, in the woods were sassafras trees that held their own for size with the oaks and hickory; although the trunks were not quite so large their heads were held well up with their more pretentious neighbors. I have taken the logs to mill and had them sawed for lumber and used it for many purposes and was greatly pleased with it in places where strength and lightness were desirable. I call to mind a set of sassafras hay shelvings

in use for over twenty years that were never painted. They were light, strong and very durable.

Since reading the letter referred to I have put a string around a venerable tree of the *Sassafras officinale* growing near and found its girth two feet from the ground to be 130 inches, or a diameter of 43 inches—certainly a quite dignified tree. This stands in the open field and is as broad and spreading as an oak in the same circumstances. It is very picturesque and greatly admired by all lovers of fine trees. I have known it for fifty years, and men that were old when I first knew it told me that it was just as large ever since they knew it as boys, so it would seem that the memory of man runs not back when it was not a respectable tree.

I am a great admirer of the sassafras as an ornamental tree and think the example of the English, who are quick to see beauty in our forest trees, may well be copied in planting this tree. There is only one drawback ; it is apt to sucker from the roots, although the one above referred to never does.

On the North Necks of this island are many large trees of the kind, but none I know quite so large in trunk, though much taller. N. HALLOCK.

Queens, L. I., Jan. 21, 1894.

A Brilliant Meteor.

LET me, in the hope of securing other accounts of the same phenomenon, report a remarkably fine meteor just seen by me.

As I, with a large number of other persons, was leaving the train at Newtonville at twelve minutes past six o'clock this evening a very brilliant meteor was seen to fall in the western sky.

We were looking directly west. The sky was absolutely cloudless, and the full moon was perhaps an hour high and, of course, at our backs. The meteor very much resembled a rocket or perhaps more strictly a large fire ball from a Roman candle. It came down the sky at an angle of about 45 degrees and from a point in the northwest perhaps 40 degrees above the horizon, where it first attracted our attention. It gave off many sparks and fiery streaks, which, however, remained visible in the bright moonlight but an instant. Its color was variously reported as white, blue and bluish-white. It seemed to me to be yellowish-white. It disappeared behind some buildings or a group of trees and still at full brilliancy and perhaps from 5 to 10 degrees from the horizon. From the hour at which the fall occurred and the remarkable and crystalline clearness of the sky, I am hopeful that it was observed and will be reported by many others, and that the falling body may have reached the earth before it was entirely consumed.

I have given the best judgments I can of distances in terms of degrees, but am aware that these may not be very accurate. My own impression was that the meteor was visible 5 or 6 seconds, but my nearest companion thought the time was fully 10 seconds.

The apparent rate of movement was that of a rocket after its culmination but before it has fallen very far, *i.e.*, the motion was slow as compared with that of many "shooting stars." C. H. AMES.

Newtonville, Mass., Jan. 19, 1894.

The Erilepidinæ.

IN my recently published "Families and Subfamilies of Fishes" (p. 135) appears the family *Anoplopomidæ* with the subfamilies *Erilepidinæ* and *Anoplopominæ*. In answer to a question, what is the former (and which may be repeated), I would state that *Erilepidinæ* is a subfamily for *Erilepis*, and that the generic name is simply a substitute for *Myriolepis* of Lockington. Lockington's name was given in 1880, but Egerton, in 1864, gave the same name to a Triassic genus of palæoniscoid fishes, and consequently another has to be supplied for Lockington's genus.

The *Anoplopomidæ* are closely related to the *Hexagrammidæ* but appear to me to be sufficiently distinct. *Erilepis* (=*Myriolepis* Lock.) is most nearly related to *Anoplopoma*, and both undoubtedly belong to the same family. *Erilepis* is not closely related to *Agrammus*, with which it has been associated.

Myriolepis (Egerton) has been well differentiated by A. S. Woodward in the second volume of his "Catalogue of the Fossil Fishes" (pp. 430–515).

THEO. GILL.

Washington, D. C.

Fungi and Insects.

IN a late number of *Science* (No. 556, pp. 218, 219) Professor McCarthy discusses, under the head of "Fungi versus Insects," methods which have recently been largely used for the prevention of insect and fungous depredations. He seems to decry especially the use of fungicides, believing that they lead to more slovenly methods of cultivation and a neglect of hygienic plant conditions. The modern tendency is to prevent diseases rather than to await their coming and then cure them ; and Professor McCarthy seems to be arguing against one of the most potent agents which science has called to the aid of the agriculturist. There is no one to defend the practice of some grape-growers of using copper preparations so freely as to "plaster" the fruit with chemicals. The fault lies not with the remedy but with the method of applying it. If the directions given in every bulletin on fungicides be followed, there is no reason for having the fruit coated or even spattered with copper. Neither does it seem any argument in favor of abandoning the use of fungicides because they still cause a loss of $300,000,000 a year ! The question of course is, how much greater would the loss have been if fungicides had not been used at all. It has been shown in a recent bulletin of the Department of Agriculture[1] that over $30,000 was saved by only 250 growers in treating diseases of the grape alone. Other experiments have shown that many other diseases, such as apple scab, potato blight or rot, strawberry blight, etc., can be entirely prevented by the proper use of copper or other preparations. Furthermore, the argument advanced that, because the labor of one man or of two men can be vitiated by the lack of attention of a third, no good has resulted, is certainly fallacious.

It is difficult to see how "pathogenic, contagious disease-producing fungi or bacteria" can remedy matters very much as far as fungous diseases are concerned. It is scarcely probable that methods which are applicable for the destruction of insect enemies to plants, such as micro-organisms, can be used with success to destroy the fungi that may attack the same plants. While "an automatic antipest destroying agent" would be a good thing, supposing such a thing to exist, would the slovenly farmer become any less slovenly through its use ? Or would the careful farmer be any less or any more careful ? The investigations of Professor Forbes in Illinois and Professor Snow in Kansas have been instrumental in decreasing the ravages of the chinch bug and saving large sums of money to the farmer. These experiments have not, however, proceeded far enough to enable us to congratulate ourselves that we will be able to supply the necessary ammunition to destroy all noxious insects. Let us hope it will be

[1] Bull. No. 3, Div. of Veg. Path., p. 69.

so. But meanwhile there is no good reason for condemning the use of insecticides and fungicides because they have not proved to be the universal panacea for all the farmers' ills.

I believe it may be asserted without fear of successful contradiction that fungicides, and especially Bordeaux mixture, properly made and properly used, will repay many times over the cost of manufacture and application. When in addition to this we have good farming there is every reason for confidently expecting results which without their aid it would have been impossible to secure.

JOSEPH F. JAMES.

Washington, D. C., Dec. 22, 1893.

Expressions of Emotion in Birds' Song.

FROM the note of Mr. B. S. Bowdish I see that *Science* has taken up the question of expression of emotions in the "song" of birds. First of all, I hope to be allowed to refer to Severin Petersen's excellent book, "Vore Langfugle" (Our Singing Birds), published by Gad in Copenhagen, Denmark.

Then, I wish to immortalize the name of Hans, a canary bird, and a comfort to our home for about eight years. I have watched this bird, and know more about him than anybody else.

1. When I entered my rooms, and called him by name, he would say his "pip" with a sweet, whistling sound; he plainly was glad, and whenever I repeated his name his kind "pip" would sound through even three walls. 2. When he happened to see his enemies, the sparrows, or another male bird, Hans used to start a loud, shrill "song," laying his wings close to his body, while the feathers on his throat were standing almost straight out from the skin. This shrill song was different from 3, the song that came from him (*a*) when he was singing to the female or (*b*) when he sang just because he was glad. 4. If anybody scared our bird, a "pip" was heard from him, but different from that mentioned under 1. It was now uttered subdued, *sotto voce*, and with the bill *closed*; it sounded like "mi-i." This was especially the case when the bird saw a hat; there was nothing in the world of which the bird was more afraid than a hat or an umbrella. Though I am tempted, I shall venture no generalizations. When he became excited, he would sing even while eating, and so he would when he saw me. A *Dracaena* now shades his grave. Here is a question which should be taken up, like that of expression of emotion in man. Abundance of facts is noted (see the various volumes of Humboldt) and may be collected from many sources. It is a fascinating biological question which ought to be worked up *experimentally* also. I agree with Mr. Bowdish that there are many observers of birds who could not fail to see expressions of emotion in birds' song, when their heart is in their study. Stating the facts above, I hope that somebody will take up the question. I should be much mistaken if all conscious beings gifted with a voice could not express their emotions that way.

J. CHRISTIAN BAY.

Ames, Iowa, Dec. 11, 1893.

BOOK-REVIEWS.

The Ore Deposits of the United States. By JAMES F. KEMP, A.B., E.M., Professor of Geology in the School of Mines, Columbia College. New York, The Scientific Publishing Company. 1893, 256 p., ill., $4.

PROBABLY no branch of geology is possessed of so scant a literature as is that treating of its economical relations, and yet certainly no branch of this science is more deserving of notice from its highly practical bearing upon the development of a country's resources. Prof. J. D. Whitney's "Metallic Wealth of the United States" (1854) was eagerly welcomed, but while this work has become classic it has become, also, of mere historical value. New mines have been opened in regions then unknown, new resources have been discovered and new methods of metal winning introduced, while, on the other hand, deposits then of greatest value have been worked out and deserted, and this not alone in the case of individual mines but over vast fields embracing wide areas of country. It is then in the scattered literature and in the works of foreign authors that American students of to-day have been compelled to seek a knowledge of American ore deposits. Moreover, the class most in need of this information, and for whom it would have the greatest value, is precisely that class to whom, from location and other causes, this scattered and foreign literature is least available. Nor are the foreign authors exact in their descriptions of American localities; authoritative writing can only come with extended study and the personal acquaintance gained by residence. For purposes of study and reference a correlation of our literature is necessary, and this can, necessarily, be accomplished only by one thoroughly-acquainted with the ore deposits themselves.

The present work by Prof. J. F. Kemp has been received with greatest applause by all interested in mining and in economic geology. Concise in itself, it supplies an exhaustive reference to original papers, and places at once in the hands of the student or engineer a key to more extended research. As stated by the author in his preface, the purpose of the book is two-fold; first, it is intended to supply a condensed account of the metalliferous resources of the country which will be readable and serviceable as a text book and work of reference; and, second, it is hoped that the work will stimulate a study of the phenomena described. In carrying out this purpose the best work of recent investigators on the origin and changes of rocks, by microscopic study, and by the artificial production of ore and gangue material, has been constantly kept in mind. An acquaintance with geology and mineralogy is presupposed, only the more general geological facts and principles being given in Chapter I., together with the geological scale and the geographical distribution of the principal geological groups. Chapter II. discusses the formation of cavities in rocks, embracing those produced by local contraction and those formed by the more extensive movements in the earth's crust. Chapters III. and IV. treat of the minerals important as ores and on the filling of mineral veins. Lateral secretion, ascension by infiltration, replacement and other theories are here ably discussed, the author rejecting the contemporaneous formation, decension and sublimation of von Cotta's summary in the *Erzlagerstatten*. The theory of electrical activity, once so popular, is given in brief at the end of Chapter V. This chapter describes in some detail the structural features of mineral veins, the changes in character of vein filling and the secondary alteration of the minerals in veins. Chapter VI., the last of Part I., discusses exhaustively the classification of ore deposits. While a systematic arrangement, such as is possible in mineralogy, would fail in the grouping of ore deposits owing to the diversity of material and lack of definite demarkations, still this subject is of vast importance, and a classification is absolutely necessary to intelligent discussion and description. The author has given in summary the various classifications which have been proposed, grouping them under the following several heads: *a*. schemes involving the classification of veins only; *b*. schemes based upon form; *c*. schemes based partly upon form, partly upon origin;

d. schemes based largely upon origin; *e.* schemes based entirely upon origin. The latter includes the classification proposed by Professor Kemp, which is in part as follows: I. Of igneous origin. Excessively basic developments of fused and cooling magmas. II. Deposited from solution, including, among other sub-divisions, surface precipitations, disseminations (impregnations), contact deposits and segregations. III. Deposited from suspension, including metalliferous sands and gravels and residual concentrations.

Part II. treats of the deposits of the various ores found in this country, including iron, copper, lead, zinc, silver, gold, aluminum, antimony, arsenic, bismuth, chromium, manganese, mercury, nickel, cobalt, platinum, tin, etc. Finally are given general remarks upon the distribution of the ore deposits in this country, with addenda relating to various special subjects. It will be seen from the above summary that the ground has been well covered, producing a most valuable manual, with a presentation of the latest theories in economic geology and a description of American mines which can not fail to be of greatest value to all interested, directly or indirectly, in these fields.

An Introduction to General Logic. By E. E. C. Jones. London and New York, Longmans, Green & Co.

This is a systematic treatment of logic intended for beginners, and is written on the lines laid down by the author's "Elements of Logic," previously published, a work more controversial and also more fragmentary in character. There is so much that is new under nearly all the topics discussed that these two books may be regarded as a distinct step in advance in formal logic, provided, of course, that the novelties do not turn out when examined to be valueless. There is a new definition of the science, a new description of the import of propositions, a new terminology for the forms of inference, several forms themselves new, a new rendering of the laws of thought and the axiom of syllogism, a new division of fallacies and a new formula and derivation for the syllogistic rendering of induction, besides subsidiary classifications, distinctions and doctrines in detail. The novelties are nearly all connected with the peculiar standpoint taken to begin with, that logic is a science of relations between propositions, followed by an analysis of the import of propositions which includes an indentity of that to which the terms are applied along with a diversity of aspect marked by the distinctness of terms. This much at least may be said for such an analysis, that whether correct or not, it is explicit on a point where most logics are confused or evasive, and this explicitness allows the subsequent rules of inference to be stated in a clearer way than ordinarily, and serves as basis for a glance at, and perhaps a contribution to, many of the bewildering and shifty problems which at every turn stay the logical wayfarer of every generation. Among the problems so treated are the qualification of the predicate, the adaptation of current words for logical terms, and the subservience of the canons of experiment to the axiom of inductive generalization.

The scope of the topics included resembles the Conceptualist plan of treatment rather than that of Mill and his school. It is thus restricted because Mill's width was purchased by a sacrifice of consistency. Mill's analysis of import was less formal, and admitted differing relations which lay on no uniform level of abstractness; and his consequent discussions wandered over the field of science arbitrarily. To Miss Jones's main outline, however, is appended a brief sketch of such of the methodology in Mill as lies outside the boundary of her own scheme, and finally a very complete index and vocabulary furnishes the student for further reading and for examinations. We regret to notice several misprints which should be removed in a second edition. Miss Jones's style of writing is eminently suggestive, though perhaps too severe to suit a superficial or unintelligent reader.

THE POPULAR SCIENCE MONTHLY
FOR FEBRUARY.

From Creation to Evolution. I. The Visible Universe. By Andrew D. White, LL.D.

This is the first of a group of papers by Dr. White which are intended to show that the modern scientific conception of the universe, including man and his activities, has been developed out of the theological and metaphysical conceptions through a continuous progression. Readers of the Monthly will find the subject traced with all the wealth and definiteness of evidence which always characterize Dr. White's writings. These papers are in continuation of the series "New Chapters in the Warfare of Science."

Tyndall and his American Visit. By Miss E. A. Youmans.

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Heredity in Relation to Education. By Prof. Wesley Mills, M.D.

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NOTES AND NEWS.

J. McKeen Cattell, M.A., Ph.D., Professor of Experimental Psychology in Columbia College, has in preparation a work entitled "A Course in Experimental Psychology." Laboratory instruction in experimental psychology is now given in the leading universities of America, Great Britain, Germany, and France, but owing to the recent introduction of the subject, there is no text-book. A laboratory handbook on the lines which have been proved useful in physical and biological science will make instruction easier for the teacher and more profitable for the student, and will permit the introduction of the subject in colleges where it could not otherwise be taught. It is to be published by Macmillan & Co.

—Probably no American vegetable product is appeciated less than the commonest and most useful of all, namely, our maize or Indian corn, which Dr. John W. Harshberger, of the University of Pennsylvania, has made his especial study for the past three years. His results have just appeared in an attractive volume which forms the second number of the contributions from the Botanical Laboratory of the University. Its botanical side is now more valuable than its study of the history of the plant and its economic importance. Dr. Harshberger has carefully exhausted the field of philology, archæology, and history in his investigation into the origin of the plant, which has hitherto been so uncertain. His conclusion, based upon a series of well-represented convergences, is that the plant originated in Central Mexico, between the 22nd parallel and the river Coatzocoalcos, and was first cultivated by the Nayas. From them it was spread southward along the entire west coast of South America, and northward over the great territory where it is now found. Light was thrown on this research by botany and meteorology, a very primitive form of maize having been found in 1890 in Mexico, which has afforded many points in the evolutionary history of the plant. Probably no part of the work would attract more attention from the average reader than the table of the principal products of the maize plant, ranging from whiskey to soap, and from paper to baskets. Improved machinery is making it possible to use every part of the plant, and its utility, as exhibited by Dr. Harshberger, is quite surprising. The economic portion of the work is a careful review of the conditions determining the agricultural prosperity of the nation, and an appeal for a wider cultivation of maize in the districts for which it is best fitted. The work is accompanied by several excellent maps and botanical charts, and has been recognized already in scientific circles as an important addition to our knowledge of American plants.

—The first volume of the new series of the catalogue of scientific papers published by the Royal Society of London is now ready. Vols. I to VI form the first series and cover the years 1800–1863, while the second series is from 1864 to 1873. Vol. IX commences the third series, which comprises the titles of papers published or read during the decade 1874–1883. They have been compiled on the same plan as the second series, and in like manner include a certain number of titles which were omitted in former volumes. The numbering of the titles of the papers of each author whose name does not now appear for the first time is consecutive with that in former volumes. The list by no means comprises the whole of the scientific periodicals, which at the present day are being constantly published in various languages, but a supplementary volume will probably be issued, in which will be catalogued all the most important papers that have appeared from 1800 to 1883 in periodicals not hitherto indexed. Vols. X and XI, completing the third series, are already in press.

—Richard L. Lull has been appointed assistant professor of zoölogy at the Massachusettes Agricultural College. Since his graduation from Rutgers Professor Lull has been in the employ of the Entomological Division of the United States Department of Agriculture at Washington, and has done special work in Maryland.

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WANTED.—Second-hand books on osteology, embryology, and comparative anatomy. Send list, stating condition and cash price. Can offer a few good sets of birds' eggs if desired. R. C. McGregor, Palo Alto, California.

WANTED.—A copy of Chapman's Flora of the Southern United States. I have on hand for sale or exchange sets of the lichens of this vicinity. List furnished on application. Address, C. F. Maxwell, Box 127, Dublin, Tex.

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WANTED.—Vol. Birds of the Standard or Riverside Nat. Hist. Preferred in parts. F. A. Lucas, U. S. National Museum, Washington, D. C.

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Why Have the Old Rods Failed?

When lightning-rods were first proposed, the science of energetics was entirely undeveloped; that is to say, in the middle of the last century scientific men had not come to recognize the fact that the different forms of energy—heat, electricity, mechanical power, etc.—were convertible one into the other, and that each could produce just so much of each of the other forms, and no more. The doctrine of the conservation and correlation of energy was first clearly worked out in the early part of this century. There were, however, some facts known in regard to electricity a hundred and forty years ago; and among these were the attracting power of points for an electric spark, and the conducting power of metals. Lightning-rods were therefore introduced with the idea that the electricity existing in the lightning-discharge could be conveyed around the building which it was proposed to protect, and that the building would thus be saved.

The question as to dissipation of the energy involved was entirely ignored, naturally; and from that time to this, in spite of the best endeavors of those interested, lightning-rods constructed in accordance with Franklin's principle have not furnished satisfactory protection. The reason for this is apparent when it is considered that the electrical energy existing in the atmosphere before the discharge, or, more exactly, in the column of dielectric from the cloud to the earth, above referred to, reaches its maximum value on the surface of the conductors that chance to be within the column of dielectric; so that the greatest display of energy will be on the surface of the very lightning-rods that were meant to protect, and damage results, as so often proves to be the case.

It will be understood, of course, that this display of energy on the surface of the old lightning-rods is aided by their being more or less insulated from the earth, but in any event the very existence of such a mass of metal as an old lightning-rod can only tend to produce a disastrous dissipation of electrical energy upon its surface,—"to draw the lightning," as it is so commonly put.

Is there a Better Means of Protection?

Having cleared our minds, therefore, of any idea of conducting electricity, and keeping clearly in view the fact that in providing protection against lightning we must furnish some means by which the electrical energy may be harmlessly dissipated, the question arises, "Can an improved form be given to the rod so that it shall effect this dissipation?"

As the electrical energy involved manifests itself on the surface of conductors, the improved rod should be metallic; but, instead of making a large rod, suppose that we make it comparatively small in size, so that the total amount of metal running from the top of the house to some point a little below the foundations shall not exceed one pound. Suppose, again, that we introduce numerous insulating joints in this rod. We shall then have a rod that experience shows will be readily destroyed—will be readily dissipated—when a discharge takes place; and it will be evident, that, so far as the electrical energy is consumed in doing this, there will be the less to do other damage.

The only point that remains to be proved as to the utility of such a rod is to show that the dissipation of such a conductor does not tend to injure other bodies in its immediate vicinity. On this point I can only say that I have found no case where such a conductor (for instance, a bell wire) has been dissipated, even if resting against a plastered wall, where there has been any material damage done to surrounding objects.

Of course, it is readily understood that such an explosion cannot take place in a confined space without the rupture of the walls (the wire cannot be boarded over); but in every case that I have found recorded this dissipation takes place just as gunpowder burns when spread on a board. The objects against which the conductor rests may be stained, but they are not shattered.

I would therefore make clear this distinction between the action of electrical energy when dissipated on the surface of a large conductor and when dissipated on the surface of a comparatively small or easily dissipated conductor. When dissipated on the surface of a large conductor,—a conductor so strong as to resist the explosive effect,—damage results to objects around. When dissipated on the surface of a small conductor, the conductor goes, but the other objects around are saved.

A Typical Case of the Action of a Small Conductor.

Franklin, in a letter to Collinson read before the London Royal Society, Dec. 18, 1755, describing the partial destruction by lightning of a church-tower at Newbury, Mass., wrote, "Near the bell was fixed an iron hammer to strike the hours; and from the tail of the hammer a wire went down through a small gimlet-hole in the floor that the bell stood upon, and through a second floor in like manner; then horizontally under and near the plastered ceiling of that second floor, till it came near a plastered wall; then down by the side of that wall to a clock, which stood about twenty feet below the bell. The wire was not bigger than a common knitting needle. The spire was split all to pieces by the lightning, and the parts flung in all directions over the square in which the church stood, so that nothing remained above the bell. The lightning passed between the hammer and the clock in the above-mentioned wire, without hurting either of the floors, or having any effect upon them (except making the gimlet-holes, through which the wire passed, a little bigger), and without hurting the plastered wall, or any part of the building, so far as the aforesaid wire and the pendulum-wire of the clock extended; which latter wire was about the thickness of a goose-quill. From the end of the pendulum, down quite to the ground, the building was exceedingly rent and damaged. . . . No part of the aforementioned long, small wire, between the clock and the hammer, could be found, except about two inches that hung to the tail of the hammer, and about as much that was fastened to the clock; the rest being exploded, and its particles dissipated in smoke and air, as gunpowder is by common fire, and had only left a black smutty track on the plastering, three or four inches broad, darkest in the middle, and fainter towards the edges, all along the ceiling, under which it passed, and down the wall."

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CONTENTS.

DUST FROM THE KRAKATOA ERUPTION OF 1883 . . 57
FAMILIARITY OF CERTAIN WOOD BIRDS. Mary Hyatt 58
THE RELATION OF THE SOUNDS OF FOG SIGNALS TO OTHER SOUNDS. Charles A. White 59
THE ENEMIES OF LEPIDOPTEROUS PUPÆ ENCLOSED IN BARK-FORMED COCOONS. Edward B. Poulton 62
AN OBSERVATION ON THE TERMINAL VERB IN INFANT SPEECH. E. W. Scripture 62
THE COLUMBIAN AND THE CENTENNIAL EXPOSITIONS 63
OWL NOTES. A. W. Anthony 64
LETTERS TO THE EDITOR:
NATIVE CALENDAR OF CENTRAL AMERICA AND MEXICO. Cyrus Thomas 65
RAINING WORMS AND FROGS. Francis Huberty James 65
FROST PLANTS. Lester F. Ward 66
CORAL REEF FORMATION. George H. Perkins 66
EARTHQUAKES IN THE SAN JUAN MOUNTAINS. Geo. H. Stone 66
AN EXPLANATION OF THE ROPE OF MAGGOTS. S. W. Williston 66
PETRIFIED EYES. Geo. G. Groff 66
"DO EARTH WORMS RAIN DOWN?" Wm. Osburn 66
THE MYSTERY OF WORMS IN RAIN. C. D. McLouth 67
BOOK-REVIEWS 67
NOTES AND NEWS 68

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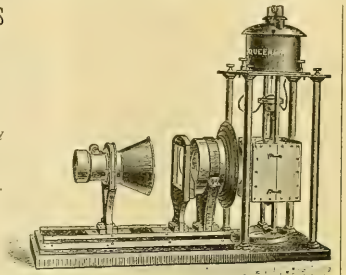

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First inserted June 19, 1891. No response to date.

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SCIENCE

NEW YORK, FEBRUARY 2, 1894.

DUST FROM THE KRAKATOA ERUPTION OF 1883.

[THE following article is a condensation of some earlier publications by Joseph Wharton, of Philadelphia, and formed a contribution by him to the papers read at the one hundred and fiftieth anniversary of the American Philosophical Society. The work of proving the origin and cause of the beautiful glowing skies that are so well remembered seems to have been assumed by this first American metallurgist as a recreation for his leisure hours. If Mr. Wharton would write of his long, laborious and successful efforts in introducing into America the manufacture of zinc and nickel and of his metallurgic work at his great Bethlehem steel furnaces, he would add a series of most valuable chapters to the history of the great industries upon which the prosperity of our country is based.—ED.]

The splendid roseate glows which in the winter of 1883–4 were visible in the western sky after sunset and in the eastern sky before sunrise gave rise to many conjectures, but apparently to almost no experiments. A few persons believed those glows to be sunlight reflected from the under surface of a stratum of fine solid particles suspended at a great height in the atmosphere; some thought with me that those particles might be volcanic dust which had floated to us from the eruption at Krakatoa, but, as no one offered any proof of this, I attempted on the morning of Jan. 20, 1884, to demonstrate it. Six miles northward from the centre of Philadelphia, where I reside, a light and fine snow was then gently falling in an almost calm atmosphere, presumably from a high altitude. Of that snow, while it was yet falling, I collected about a gallon by skimming it carefully with my hands from a considerable surface in a field a hundred yards to windward of my house and a quarter-mile from the nearest windward building.

This very clean new-fallen snow I melted under cover in the porcelain bowl it was gathered in, and was at first unable to detect any sediment; after maintaining for several minutes a gentle rotary movement of the bowl in order to bring into its deepest part any solid matter which might be present, I poured off the water and evaporated the remainder. A minute quantity of fine dust was then discerned by the tiny vitreous reflections which it gave in the sunlight; my practice in chemical analysis, and therefore in weighing small quantities, affords some justification for the estimate that the total weight of this dust was less than one-hundredth of a grain.

Under the microscope, where it was immediately placed, this dust showed the characteristics of volcanic glass; it consisted in part of irregular, flattish, blobby fragments, mostly transparent and showing no trace of crystalline structure, in part of transparent filaments more or less contorted, sometimes attached together in wisps and mostly sprinkled with minute glass particles. The filaments of glass had about the same diameter as single filaments of silk placed on the microscope slide for comparison with them.

Having microscopically examined the dust again and again, I ignited it upon platinum to destroy any organic matter which might be present, and thereafter found the filaments, the flat plates, and the amorphous accretions of glass quite unchanged.

No pyroxene, augite, or magnetite, such as have elsewhere been observed in volcanic dust, was present; it may be assumed that, if at first mingled with the glass, those heavier minerals had been dropped during the long voyage of more than ten thousand miles of space and more than four months of time.

The capacity of fine volcanic glass to float in the air to considerable distances being a well-established phenomenon, my examination claims no greater novelty or interest than what may be due to the actual finding of such glass at so great distance from the point of its ejection.

In this case two separate ejections seem to be indicated, for on several evenings I observed a second and fainter glow after the original and stronger glow had entirely disappeared. A higher stratum of finer particles doubtless reflected the sunlight from the greater altitude after the sun had set at the lower elevation of the principal dust stratum.

Early in February, 1884, the ship J. E. Ridgeway arrived at Philadelphia from Manila by the Strait of Sunda. On Feb. 12 I visited that ship, and read on her log-book that at 10 p.m., Oct. 27, 1883, in south latitude 7° 57′ and east longitude 100° 54′ (about five hundred miles W.S.W. from Krakatoa), she encountered a vast field of floating pumice, through which she sailed until 7 a.m., Oct. 29. So abundant was this pumice that the ship's speed was reduced from nine knots when she entered it to two knots at 6 p.m., Oct. 28; several hours after that time her speed gradually increased, as the pumice became less dense, from two knots to eight, and finally, when she cleared it, to her normal nine knots. No volcanic ash had fallen upon the ship, as she arrived too late upon the scene.

Some of this pumice I took directly from the hands of the mate and steward, who had collected it from the sea and had kept it in their private lockers. It can scarcely be doubted that this pumice was ejected from Krakatoa.

Now, on placing under the microscope small crumbs of that pumice and filaments picked out from its cavities, I recognized just such transparent flattish scraps and ragged accretions as were among the dust found in the snow-fall of Jan. 20, while the filaments, though less varied and interesting than those then collected, where quite similar in character, even to the tiny glass particles sprinkled on them. A minor point of resemblence was that the yellow color of one little vesicular mass in the dust caught Jan. 20 was fairly matched by a slight streak of similar color in the pumice.

In March, 1884, I collected dust from the steel works at South Bethlehem, Pa., and also dust from a blast furnace there, in order to compare them with the dust

found in the snow and with the filaments and crumbs of pumice from the ship J. E. Ridgeway.

After separating from these dusts the large proportion which was attracted by the magnet, the remnant showed in each case many vitreous particles ; that from the iron furnace largely spheroidal or globular, with a few filaments ; that from the steel works partly minute rounded particles, but containing many filaments of great tenuity. Neither contained such clear vitreous plates and aggregations as abounded in the snow-dust, while the filaments in both cases were of dark color, and smooth, straight form, distinctly different from the colorless and frequently contorted filaments of the snow-dust.

It is difficult to resist the conclusions (1) that the vitreous dust found in the snow-fall of Jan. 20, 1884, was not derived from iron or steel furnaces, (2) that it was of similar origin to the floating pumice found by the ship J. E. Ridgeway, (3) that it was ejected by the huge volcanic explosions of Krakatoa.

To meet the objection which might be urged, that this account cannot be regarded as accurate because written so long after the occurrences, I add that it is simply condensed from three successive articles contributed at the time to the *Public Ledger*, of Philadelphia, describing respectively the finding of the vitreous dust in the snow-fall, the examination of pumice from the ship Ridgeway, and the scrutiny of furnace dusts.

FAMILIARITY OF CERTAIN WOOD BIRDS.

BY MARY HYATT, STANFORDVILLE, N. Y.

SOME of our wood birds depart occasionally from the prescribed course laid down for them by ornithologists, and come to our orchards and lawns, instead of haunting deepest woods and distant solitudes, as the authorities say they should.

A certain lawn surrounding a dwelling in Dutchess County is often favored with the presence of various wood birds—not transient visitors only, but birds that make themselves thoroughly at home in the garden and yard, sometimes building nests quite near the house. Beyond the garden there is a ledge of rocks, around and over which bushes and trees are allowed to grow, forming an attractive spot to these fugitives from the forest.

One summer a pair of wood pewees (*Contopus virens*) nested in a towering honey locust that stood five feet from the piazza. The trunk of the tree was crusted with gray lichens, with which the pewee coats the outside of its nest, the inside being usually composed of scraps of wool and inner fibres of decaying bark. The domicile of these sociable pewees was saddled upon a horizontal limb of the honey locust about thirty feet from the ground. By looking from the top-floor windows, one could just see the heads of the young projecting from the top of the nest. Now and then a parent bird appeared with a moth or some such delicacy for the little ones. The old birds spent much time on a wire fence between the garden and meadow. From there they made frequent dashes after insects, returning to their wire perch, where they remained for hours each day, quietly indifferent to all passers. The pewees seemed to have great confidence in their human neighbors. One day, as an occupant of the dwelling was walking leisurely along near the fence, one of the pewees darted down and snatched a little insect from the shoe of the passer, then flew serenely back to the wire again.

The redstart is another frequenter of this yard and orchard. Its nest has not been found, but it is more than probable that it has nested somewhere about the yard, which is well supplied with trees and shrubbery. The redstarts have been seen feeding young birds near the door, but they dart about so swiftly that it is no easy matter to find their nesting places. They often came about the door, sometimes hopping tamely on the ground, and once a redstart flew in the open doorway, picking up a crumb from the floor and departing as suddenly as he came.

A pair of wood thrushes started house-keeping one summer in a plum-tree by the driveway. The nest was built, and the eggs were laid when Madam Thrush met with untimely death. She was found gasping on the door-stone one morning, and in a few moments the bird was dead. It was supposed that she had dashed against a window, thinking to fly through. The mate of the dead bird lingered a couple of days in the vicinity of the nest, and then departed from the premises, returning no more to his favorite lawn, where he had explored the flower-beds for many a day, sometimes singing on the very door-stones.

The crested flycatcher (*Myiarchus crinitus*) occasionally makes himself quite prominent about the grounds. One year there were several of these saucy fellows calling so constantly and noisily through the yard for two or three weeks in May that they attracted much attention.

The oven bird is one who delights in parading the flower-beds or walking the garden wall when he thinks no one is looking. Upon one occasion we caught him promenading the piazza, walking briskly up and down until his curiosity was satisfied, when he darted away, sounding a lively crescendo from behind the trees.

—The latest number of the *American Journal of Psychology* (edited by G. Stanley Hall, Clark University, Worcester, Mass.) opens with an extensive article (pp. 145–238) by T. L. Bolton, on "Rhythm," in which the author discusses interestingly the almost untouched field of the psychology of rhythmic phenomena,—treating of physiological rhythms, attention and periodicity, rhythmic speech, time relations, intensity of sounds, qualities of sounds, emotional effects of rhythm upon savages and children, rhythmic, music and poetry. The main bulk of Mr. Bolton's paper is taken up, however, with the tabulation and explanation of the results of many valuable experiments on rhythm carried out in the Psychological Laboratory of Clark University. "Minor Studies from the Psychological Laboratory of Cornell University," "Mediate Association," by H. E. Howe, and "Sensorial and Muscular Reactions," by A. R. Hill and R. Watanabe, are communicated by Prof. E. B. Titchener. Mr. Howe's experiments seem to controvert Scripture's "Mediate Association." Mr. J. A. Bergström contributes a careful "Experimental Study of Some of the Conditions of Mental Activity." The experimental work upon which the paper is based was done in the laboratory of Clark University in the last two years. The questions treated of are chiefly "Natural Rhythm of Mental Activity" and physiological memory. Mr. F. B. Dresslar publishes "A New Illusion for Touch, and an Explanation for the Illusion Displacement of Certain Cross Lines in Vision," besides a "New and Simple Method for Comparing the Perception of Rate of Movements in the Direct and Indirect Field of Vision," two interesting additions to the stock of laboratory experiments. Mr. J. S. Lemon has a brief paper on the "Psychical Effects of the Weather," a subject with which he promises to deal more in detail on a future occasion. The number concludes with the usual extensive review of the literature of anthropological psychology, nemology, morbid psychology, instinct and experimental psychology.

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THE RELATION OF THE SOUNDS OF FOG SIGNALS TO OTHER SOUNDS.

BY CHARLES A. WHITE, SMITHSONIAN INSTITUTION, WASHINGTON, D. C.

IT is now generally known that within the range of possible audibility of most, if not all, the fog signals which the various civilized governments have established along their coasts, each usually in connection with a lighthouse, there are certain areas within which the sound of these signals are inaudible. It is also known that areas of more or less complete inaudibility of sounds, when projected from certain directions, sometimes occur upon the land; but only those which occur upon the water will be specially referred to in this article, and they will be discussed only with reference to their relation to stationary fog signals. Such acoustic conditions being a constant menace to navigation during a fog, the various governments concerned have instituted inquiry into the character and limitations of those areas and, incidentally, into their causes. Our own government has been, and still is, active in experimental studies of this kind, but the records do not show that any of those studies have been more than incidentally directed to that particular phase of the subject which is indicated by the title of this article.

The areas of inaudibility referred to are of two kinds, each area of both kinds bearing a similar special relation to a neighboring fog signal. One of these kinds is made such in every case by a true acoustic shadow of a stationary visible object, usually a small elevated island, or a ridge of land running out into the water, at, or near, one side of which the fog signal is located. That is, such an area is simply one which an essentially permanent acoustic shadow occupies.

The areas of inaudibility of the other kind occur in broad open waters. There is never any visible indication of their presence, and in connection with, or near, none of them is there any visible object above the water surface, and therefore nothing which could cast a true acoustic shadow there. Whatever may be the cause or causes of inaudibility of the sounds of the neighboring fog signal in areas of this kind, it is evident that at least a considerable part of the acoustic conditions prevailing in them are in effect identical with conditions which characterize the other kind. That is, certain of the effects produced within these areas are the same as those which are produced by a true acoustic shadow in each of the first mentioned kind of areas.

It is impracticable to discuss these areas and to compare each kind with the other without applying to each kind a distinctive name. I have therefore selected for the first mentioned kind the name montumbral, and for the second, the name pseudumbral, areas. The first name is selected because the areas to which it is applied are in every case made such by the acoustic shadow of a hill or ridge. The second name is selected because the acoustic conditions which prevail in the kind of areas to which it is applied are, as has just been mentioned, largely identical with those which are produced in the other kind by true acoustic shadows.

The elevated island or ridge which lies between a fog signal and a montumbral area casts an acoustic shadow over the latter just as at night it casts an optic shadow over the same area by intercepting the light from the lighthouse with which the fog signal is connected. The bounderies of a montumbral area are therefore determined by the profile outline of the elevated island or ridge which causes it, but they are modified and restricted, as compared with those of an optic shadow, by the great lateral diffusion of the sound waves, and by their tendency to soon coalesce beyond any object which may separate or obstruct them. That is, the lateral boundaries of an optic shadow diverge beyond the intercepting object, while those of an acoustic shadow have a strong tendency to converge there. The diagram which follows further on approximately illustrates the character of a montumbal area besides other conditions which sometimes may be connected with it, as will presently be explained.

It will thus been seen that what I designate as montumbral areas are in each case identical in outline with an acoustic shadow which is necessarily permanent, or only slightly varying as to its boundaries with changes of atmospheric conditions. Beyond this, montumbral areas, unlike pseudumbral areas, as will presently be shown, are not potentially variable. Acoustic shadows occur under a great variety of conditions, but montumbral areas as I have defined them are not numerous.

Excepting the absence of the direct sounds of the fog signal within a montumbral area the acoustic conditions prevailing there are normally the same as are those which prevail on all the water surface adjacent to it. That is, in case no other acoustic shadows are cast there by other objects, intercepting other neighboring sounds, it is an area of inaudibility only of the sounds of the neighboring fog signal and of such other sounds as may be projected from points within a limited distance upon either side of the fog signal. This inaudibility is caused by a complete interception or destructive arrest, by the adjacent elevated island or ridge, of a portion of the sounds which the fog signal projects towards it. All other sounds of whatsoever kind, if sufficiently intense for such distances, may, with the following exceptions, be projected from, into, or across the area in any direction.

The exceptions are that, because the elevated island or ridge intervenes, sounds connot be projected to points adjacent to its other side from points within the montumbral area, and of course such sounds cannot reach the place of origin of the neighboring fog signal's sounds. Also, the projection of other sounds than those of the neighboring fog signal into the montumbral area from points at such distances at either side of the fog signal as accord with the length of the elevated island or ridge, will be more or less completely prevented by the presence of the latter, just as it prevents the projection of the fog signal's sounds into that area.

Pseudumbral areas are of more frequent occurrence than are montumbral areas, and in various ways they are more important. Still, their discovery is always empirical because there is never any visible indication of their ex-

istence ; and when one is discovered its shape and extent can be known only by special investigation. It is known, however, that the shape and extent of pseudumbral areas are very variable, and also that their location is uncertain as regards distance and direction from the fog signals whose sounds are inaudible within them. They are also very variable in outline, and the distinctness of the boundary of each is usually, if not always, variable in its different parts. That is, if the area may be propery designated as umbral, the term penumbral may not inappropriately be used to indicate the indefiniteness of certain portions of the boundaries of those areas.

Furthermore, certain known facts indicate that all the conditions which characterize a pseudumbral area at one time may be absent from nearly or quite the whole area at another time. These areas, therefore, unlike montumbral areas, are always potentially, and apparently always actually, variable, not only in outline but in position and duration. Still, they frequently have sufficient permanence for systematic study; and Major W. R. Livermore, Engineer in Charge of the First and Second United States Light House Districts, has successfully mapped some of them.*

Experimental study of pseudumbral areas is necessarily made on board of vessels, and as the observer directs his course away from the fog signal, which is meanwhile kept regularly sounding, he becomes aware of having reached the proximal boundary of a pseudumbral area by the gradual, or often sudden, failure of the fog signal's sounds to reach him. Continuing in that direction, if open water be there, he comes to the distal boundary of the area when the fog signal's sounds are again heard, usually with little diminution of their intensity. The biological terms, proximal and distal, are borrowed and applied to the nearer and opposite sides, respectively, of the area, with reference to the location of the fog signal.

Although, as has already been mentioned, a considerable part of the acoustic conditions which prevail in a pseudumbral area are, in effect, identical with conditions which characterize montumbral areas, two important differences between the conditions prevailing in the two areas respectively are known, besides the difference as to permanency just mentioned. First, in the case of a pseudumbral area there is no such interception or destructive arrest of any portion of the fog signal's sounds by a visible physical object as takes place in the case of a montumbral area. The inaudibility is caused by some invisible physical force or condition, but how that force acts, or what that condition really is, has long been the subject of wide differences of opinion and of earnest controversy. Second, independent sounds *can* be projected from points within a pseudumbral area to the place of origin of the neighboring fog signal's sounds, further mention of which fact will presently be made.

The cases discussed under the head of Acoustic Reversibility by Professor Tyndall,[1] and some of those related by Professor Henry[2] concerning his experiments while he was Chairman of the United States Light House Board, agree with the foregoing statements, one of the latter cases being especially important in this connection.

Many of Professor Henry's experiments were made to ascertain the relation to one another of sounds responsively produced, such, for example, as those which he made with the whistles of steamers off Sandy Hook in 1874. He showed that sounds may be returned from an area in which similar reciprocal sounds, projected from other points, are inaudible, and he urged this fact against Professor Tyndall's theory that the cause of such inaudibility is a flocculent condition of the atmosphere. The experiment which I wish particularly to refer to, however, was made with reference to the sounds of a stationary fog signal, and it is therefore of special interest to the subject of this article. The result of this experiment was the projection from within a pseudumbral area of the sounds of the whistle of the steamer upon which he was making his observations to the immediate vicinity of the neighboring fog signal. While the steamer was moving away from the fog signal, which was meanwhile kept regularly sounding, the steamer entered an area where the sounds of the fog signal became inaudible. The steamer's whistle being then blown, its sounds were distinctly heard by observers standing beside the fog signal.

Professor Henry died soon after the last of the experiments referred to were made, and they have not, to my knowledge, been continued. However, considering the facts which he then demonstrated, together with other facts concerning the acoustic conditions which are known to prevail in both pseudumbral and montumbral areas, I cannot doubt that sounds of any kind, if sufficiently intense for such distances, may be projected into or across pseudumbral areas as readily, and in the same manner, as into or across montumbral areas. That is, I think the facts now known warrant the opinion that a pseudumbral area is one of inaudibility only of sounds coming toward that side of it which faces the neighboring fog signal.

The question may be raised whether the acoustic conditions which usually prevail in connection with pseudumbral areas may not sometimes be complicated by the simultaneous presence of such an additional force or condition as would make them areas of inaudibility of certain other sounds besides those of their neighboring fog signals. I am not aware of any fact which favors the supposition that such complications ever exist, nor do I now think they are to be expected. This statement, however, has no reference to the assumed inaudibility within the pseudumbral area of sounds which may be projected from points within a short distance upon either side of the fog signal, because it is evident that, to a greater or less extent, such sounds are controlled by the same cause which controls the fog signal's sounds. The question may also be raised whether the condition which produces inaudibility of the fog signal's sounds, without reference to other sounds, may not also be complex. I am not, however, at present prepared to discuss the question of causes of inaudibility of sounds in pseudumbral areas. Still, I think that exhaustive investigations concerning the relation of the sounds of fog signals to other sounds, in connection with pseudumbral areas, are likely to throw much light upon it.

In view of the variability of those areas it is evidently desirable that various experiments showing such relation should be simultaneously made when one of them is discovered. For example, it is desirable that several vessels, each provided with the means of producing various penetrating sounds, should surround and traverse the pseudumbral area and attempt the projection of those sounds into, from, and across it in all directions; the neighboring fog signal being meanwhile kept regularly sounding. As a matter of course all such experiments should be accompanied by observations of all atmospheric conditions, especially those which affect, or which are supposed to affect, the propagation of sounds.

Such experiments would tend to show, among other things, what becomes of the sounds of a fog signal upon reaching the proximal boundary of a pseudumbral area. For example, if it should be ascertained that such sounds as I have indicated may be projected in various directions through the very space in which a fog signal's sounds are at the same time inaudible, it would demonstrate what I

[1] Tyndall, John ; Sound, 3rd edition, p. 403.
[2] Henry, Joseph ; Researches in Sound, pp. 493, 501, 503, 510 and 547.

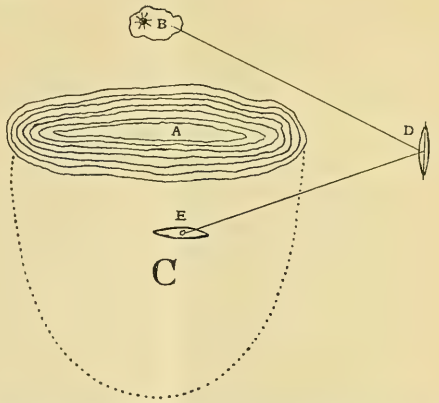
have suggested, that such inaudibility is mainly, if not wholly, dependent upon causes acting in only one direction. If then it should be ascertained that independent sounds may be projected from a point just within the proximal boundary of a pseudumbral area to a point beyond its distal boundary, it would of itself be a demonstration that the fog signal's sounds become either refracted or annulled at the proximal boundary of the area.

The frequent, if not the usual, recovery of the fog signal's sounds in strong intensity beyond the distal boundary of a pseudumbral area seems to show that there has been no permanent annulment of those sounds either at the proximal boundary or elsewhere. It also seems to indicate that their restoration is at most only in part due to such diffusion and coalescence of sound waves of the fog signal as quickly restricts the extent of a montumbral area, and makes those sounds audible beyond its distal boundary. It therefore becomes desirable to investigate the air above pseudumbral areas with a view to learning whether the fog signal's sounds pass there uninterruptedly to the distal side of the area. The investigations by balloon which have been proposed by both Mr. Johnson and Major Livermore will evidently be the means of testing this question, and they will doubtless aid in other ways to increase our knowledge of the acoustic conditions which prevail in pseudumbral areas.[3]

The preceding paragraphs are largely suggestive of scientific results yet to be attained. The facts now to be mentioned are suggestive of dangers to navigation to be avoided or guarded against. Last autumn, while a member of the party of investigation whose operations were described by Mr. A. B. Johnson in *Science* for January 5th of the present year, I made some observations of echoes of the sounds of fog signals which are of special interest in this connection. The most important of these observations were made upon Great Gull Island, at the eastern end of Long Island Sound, and the echoes were those of the fog signal, a siren, which is connected with the lighthouse on Little Gull Island, about half a mile from my point of observation. There was no fog at the time these observations were made, but the siren's sounds were given regularly that their variations of audibility might be studied in the surrounding region.

The echoes were received from the sails of several schooners which were standing in the offing with all sails set and close hauled by the wind. The vessels varied in distance from me and from the siren from half a mile to nearly two miles. The wind was light, there was perfect silence around me, and the echoes reached me with almost startling distinctness. In timbre, or quality, they were exact reproductions of the siren's sounds; and in duration and time-interval they also agreed with them. I estimated the intensity of the echoes at from 1 to 3 in a scale of 10, the latter number representing the full intensity of the siren's sounds. The angles of incidence and reflection by which they reached me were from 20, to somewhat more than 40 degrees.

Considering the intensity and distinctness of those echoes, their identity of timbre, time-length and time interval with those of the direct sounds of the siren, the distances from which they were reflected, and the broad angles of incidence and reflection by which they reached me, I was impressed with the belief that such echoes, when heard within either pseudumbral or montumbral areas, may be a source of danger to passing vessels. The following diagram will show how sail-echoes of a fog signal may be a source of danger to a vessel traversing a montumbral area in a fog, and it also illustrates the character of montumbral areas as they have already been described.



A, represents an elevated island; *B*, a small island with lighthouse and fog signal, and *C*, a montumbral area, the seat of an acoustic shadow caused by the elevated island. *D*, represents a schooner with all sails set and close hauled. *E*, represents another vessel, within the montumbral area, where of course the direct sounds of the fog signal are inaudible. Those sounds, however, reach the sails of the vessel at *D*, and are reflected to the vessel at *E*, as an echo. To persons on board the vessel at *E*, the sounds of the fog signal seem to come from the direction of *D*.

Sail-echoes of a fog signal which are recovered beyond the distal boundary of a montumbral area may, perhaps, also be reflected back into it, but lateral reflections, such as are represented by the diagram, are probably more likely to occur.

It cannot be denied that the permanent conditions necessary for the casting of an acoustic shadow of a fog signal's sounds across a navigable channel, or a usual track of vessels, are not common, but such conditions do exist in connection with certain of the fog signals which have been established along our coasts. Neither can it be denied that the occurrence of such a combination of permanent and adventitious conditions for reflecting the sounds of a fog signal from the sails of vessels into a montumbral area as is represented by the foregoing diagram is likely to be rare. Still, there is an undeniable probability that such cases may occur at any time, and it is also undeniable that they may be attended with danger whenever they do occur.

If my assumption is correct that a pseudumbral area is one of inaudibility of only such sounds as are projected towards that side of it which faces the neighboring fog signal it may legitimately be assumed that sail-echoes of the fog signal's sounds may be projected into such an area just as they may be projected into a montumbral area. That is, if a pseudumbral area should be a short one, sail-echoes of the neighboring fog signal may be projected into it laterally in the same manner that they are represented by the foregoing diagram as being projected into a montumbral area. Recovered sounds of the fog signal, upon the distal side of the pseudumbral area, may also be echoed back into that area from the sails of vessels. Such echoes may enter a pseudumbral area from any point of the compass within a range of, perhaps, one half the horizon. To persons on board a vessel traversing one of these areas during a fog those echoes might readily be mistaken for the direct sounds of the fog signal, and the true location of the latter would in every case be falsely indicated.

The conditions under which echoes occur are numberless, and their observation has from time immemorial been prominent among the practical duties of mariners. They habitually use echoes of permanent objects as aids,

[3]Since the foregoing paragraphs were written Major Livermore has informed me that in experiments lately performed under his direction the sounds of a bell and of a steamer's whistle were projected both into and out of pseudumbral areas, thus demonstrating in large part what I have suggested.

and as warnings from danger, when guiding their vessels in a fog or in darkness; and sail-echoes of sounds from their own vessels are always to them warnings of possible danger of collision. The cases which I have mentioned, however, are all of a special and accidental character. That is, they are special because they are connected only with fog signals, and accidental because they depend upon the fortuitous movements of sail vessels.

Cases of the projection of sail-echoes of the sounds of fog signals into pseudumbral areas, like those suggested for montumbral areas, will probably not be numerous, but both kinds of cases are worthy of careful investigation, not only because of the inherent importance of the subject to which they relate, but because they are incidental sources of danger which have been introduced by the establishment of fog signals.

THE ENEMIES OF LEPIDOPTEROUS PUPÆ ENCLOSED IN BARK-FORMED COCOONS.

BY EDWARD B. POULTON, M.A., F.R.S., HOPE PROFESSOR OF ZOÖLOGY IN THE UNIVERSITY OF OXFORD, ENGLAND.

THE beautiful and perfect concealment of the cocoons constructed out of bark by many species of Lepidoptera has often attracted attention and admiration. In some species, such as the British *Acronycta leporina*, the larva tunnels deeply into the bark, constructing a chamber at some distance beneath the surface, and carefully removing the bark-dust formed by its building operations. The mouth of the tunnel is closed by fragments of bark spun together so as to form a covering exactly flush with the surrounding surface, which it also resembles in texture and color. In other species a natural crack or furrow in the bark is selected by the larva and is similarly covered in level with the bark around. In the genus *Cerura* (*Dicranura*) the larvæ excavate an oval area which is covered in by a more or less domed roof, similarly built of pieces of bark so well fitted and woven together that the appearance is exactly that of some rounded, flattened or irregular projection on the trunk of the tree. Furthermore, in the choice of situation it is usually found that increased aid to concealment is afforded; the apparent projection being formed on an appropriate part of the trunk, and with due regard to the existence, arrangement and direction of the irregularities of its surface, such as furrows, etc. Those who believe in the efficiency of Natural Selection in evolution will probably regard this interesting method of concealment as the outcome of countless generations during which the attacks of enemies have been, on the whole, more successful against the products of less perfected instincts, and less so against those of the more perfected. Furthermore, we must suppose that the increasing perfection in instincts has acted selectively on enemies, sharpening their faculties, until, by action and reaction, the present high level of constructive skill has been reached, and is maintained.

How far is it possible to gain evidence of such a relationship between enemies and prey? At first sight, one of the cocoons I have described appears to be so perfectly concealed as to defy the sharpness of any enemy, however acute. But observation, especially directed to this end, will show that such an inference is incorrect.

On April 12 of the present year I was examining the bark of a black poplar (*Populus nigra*) near Yoxford, in Suffolk, and found a cocoon of the "Poplar Kitten" (*Cerura bifida*) which had evidently been recently opened by some enemy, almost certainly a bird, and the chrysalis extracted. The edges of the opening were still brown and fresh, as was the interior of the cocoon; and the larval skin remained fresh and untouched inside. The opening was in the middle of the exposed surface and not at one end, as it is when the moth emerges. Besides, the cocoon had been opened and cracked by a blow from some hard object such as a bird's beak, and the sharp irregular margins were quite different from those of the natural opening made by the moth, doubtless by means of a corrosive fluid, as in the allied species, *Cerura Vinula*, which Mr. I. H. Latter has recently shown to secrete caustic potash for this purpose. Furthermore, the moth emerges far later in the year, and, had it emerged at an exceptional time, the empty pupal skin would have been left behind in the cocoon. We may therefore safely assume that the opening was the work of an enemy, and, as the cocoon was five feet from the ground, it was probably due to some tree-creeping, bark-exploring species of bird.

After the hint supplied by this observation I found that such instances are quite common and that a considerable proportion of these cocoons are thus opened and their contents abstracted. It is probable that the attention of the enemy is directed to any cocoon-like object by the sense of sight and that the object is then tapped, and, if found to be hollow, opened and the pupa devoured. If I am right in supposing that the pupa has to run the gauntlet of such dangers as these, it follows that any carelessness in construction or in the selection of a site would tend to be eliminated, and we are able to picture to ourselves, with a considerable degree of probability, the kind of conditions under which this wonderful form of protective concealment has been developed and is now maintained.

These conclusions are perhaps capable of being brought to a crucial test, and, as this involves much time and much observation, it is to be hoped that several naturalists may attack the question. During the winter and spring a large number of such examples should be collected and noted, with special reference to the degree of concealment exibited by the opened cocoons as compared with those which are found to have escaped attack. The subjective element would require to be checked by calling in the aid of others who are ignorant of the point under consideration but possess the requisite accuracy of eye. Attention should only be paid to fresh cocoons which have been opened in the season of the observation; for the old battered cocoons of past seasons will be commonly found on the trunks. It may be that the problem demands too large a number of examples to be capable of solution in this way; but on the other hand it is possible that positive evidence may be forthcoming.

AN OBSERVATION ON THE TERMINAL VERB IN INFANT SPEECH.

BY E. W. SCRIPTURE, NEW HAVEN, CONN.

IT has sometimes been asserted that the most natural position for the verb is not at the end of the sentence, and that children would not of themselves separate the participle or infinitive from the auxiliary or main verb, as is done in German syntax. I wish to record a personal observation to the contrary.

The child, W.S., twenty-nine months old, has not learned any language but English, and has not heard any sentences constructed otherwise than according to correct grammatical rules. W. S. was told to ask for some money to buy shoes, but in doing so said, "I want some money for my shoes to buy." Upon the question "What?" the sentence was repeated without change. On other occasions W. S. uses the words in the customary order, *e. g.*, "I'm going buy new shoes." The observation seems to prove that the terminal position of the infinitive is at least not unnatural.

THE COLUMBIAN AND THE CENTENNIAL EXPOSITIONS.

Now that the world's fair at Chicago is over, the last half dollar taken from the public and the splendid buildings which have not been entirely removed either dismantled or burned, it can do no harm to compare the two world's expositions in the United States.

The first was born of a great patriotic uprising of the people—chiefly of Philadelphia—to commemorate the birth of the nation. The second was the fourth centennial of the discovery of this continent, for which enthusiasm was manufactured by means of the powerful aid of the Government, added to hitherto unheard of subsidies of money, and by means of unprecedented advertising at enormous expense undertaken by reason of the ambition of a great young city of which the motto is "I will." It is not too much to say that the Government of the United States did not expend a dollar without return for the elder exposition, while it freely gave millions for the later one.

Charles Sumner in the Senate and Mr. Springer of Illinois in the House of Representatives opposed the giving of Government support to the former, while all the representative members of every state's delegation to Congress, and notably those of Pennsylvania, united to further the objects of the later project. Had it not been for the munificence of private monied men of Philadelphia, and the contribution of small sums by her less fortunate people, the Centennial would needs have been abandoned. Yet the donations of foreign countries and exhibitors to the Government scientific museums in Washington were, in proportion to their magnitude (and perhaps actually) greater in the first exposition than in the last.

A recent communication to the public press by an observant student of the late Exposition in Chicago contains the following language:

After stating that Philadelphians must admit "the far greater richness and elaboration" of the later enterprise, it proceeds to state that the Chicago Fair "cost three times the money of the Centennial, and while it has about the same greater proportion of exhibits, it has by no means a three-fold power on national invention and progress." . . . "It is doubtful indeed if all these added millions add an ounce to the momentum exerted by the Centennial, and for the reason that everything here beyond the essentials of practice, which were demonstrated at the Centennial, are in the simple though immense direction of spectacle, constituting a bewildering appeal to the senses but not being of necessity a lasting force in industrial science."

The writer of these lines may claim both the desire and the opportunity to make a fair comparison between the two expositions in the department of mines and mining, having occupied positions in both expositions which gave him facilities for doing so.

He can only bring to the judgment of the other exhibits such qualifications as any man of ordinary intelligence and the experience of several world's fairs possesses.

The buildings; their arrangement with reference to each other and to the general architectural effect; the laying out of the grounds and all those many elements of architectural taste which are so difficult to catalogue, were never so perfectly attained in any part of the world as they were in Chicago. The buildings themselves, too, were spacious, well fitted for their purpose and imposing in their lines.

In all the above respects, and perhaps in the means of transportation of crowds to and from the grounds, the Chicago Fair was in advance of any enterprise of the kind ever undertaken.

But the appearance of the interiors was not in keeping with the majesty of the structures. Even to the superficial glance the exhibits seemed too often commonplace or "padded." Not but what there were thousands of gems imbedded in this matrix of mediocrity and advertisement, but, as is usually the case, the most striklng objects were of subordinate interest, and the really valuable objects needed careful and weary searching, and most frequently one failed to find any adequate description or competent attendant when these treasures were found. The writer first quoted excepts from his strictures the Electricity building, but to me this building was an excellent illustration of the defects alluded to. Everything which would arrest the attention of the ignorant was shown in profusion. There were masses of light of many and continually changing hues, including an illuminated column with a make-believe indicator to mystify the beholder; but the searcher for the more modern application of electricity, the apparatus for signalling electrically by means of a ray of light; the Tessla apparatus; the means of heating by electricity, etc., was unsuccessful or partially so. So far as the general public was concerned, there might as well have been no electric stoves as those placed at the end of one gallery. Outside of a favored few the visitors were able neither to see the interior working of the ovens nor to obtain any information concerning them. If there is one department in which the enormous advance since 1876 should be shown, it is that of electricity, and yet when it is considered that the Bell telephone was first brought out there and that the then latest English apparatus for exact measurement of the electrical current were exhibited in profusion, while totally lacking from the British section of the electrical display at Chicago, it is doubtful if, to say the least, any superiority can be claimed at Chicago in 1893 over Philadelphia in 1876 in this particular, so far as the instruction of the general public is concerned. For the public the most instructive object lesson of the possibilities of electricity as an agent for decoration, light, heat and power was given by the Columbian Commission itself in the brilliant illumination of the dome of the administration building, the basin, and the electric launches and intra-mural railway.

The collection of paintings, while numerous, contained in the aggregate fewer objects of rare value than many much smaller and less pretentious collections of modern days, both international and national.

The agricultural display was fine but was a disappointment to those who expected to see a full representation of the agricultural implements of all the nations of the earth which manufacture such objects. Here, as elsewhere throughout the fair, many objects whose place was in the building were sequestered by the commissioners to adorn State buildings or to meet the eyes of the more general public in the greatest building, *i.e.*, that of Manufactures and Liberal Arts.

There seems to be no difference of opinion as to the shoe and leather exhibit. With the exception of the Russians, and possibly one or two individual displays, the contents of the splendid building consecrated to this subject were disappointing or without significance.

As to the Mines and Mining, in hardly any part of this great profusion of objects was any attempt made to educate as well as to astonish the non-professional visitor.

Great piles of rocks and ores were scattered about, but utterly without system in most cases. The silver statue of Ada Rehan, the purely hypothetical miner's cabin built out of ores and the more or less artistic statue of a distinguished far western fellow citizen of the self-taught sculptor in sandstone, of which the advertisement took the place of a catalogue, were the cynosures.

As for the rest, either a few mines or localities were

more than amply represented, to the exclusion of many others equally important, or in some cases a great mining State was not represented at all. In all but one or two cases the labels, by means of which the public derives all its concrete information, were without other than local and superficial information; very often they were carefully concealed beneath the specimens they should have described, or illegible, or in a foreigh language unknown to the average visitor. In the German exhibit no account was made of the products and methods which for seven hundred years have made of Saxon Freiberg the Mecca of the miner and metallurgist. The superb collection of iron from Sweden, which was one of the chief attractions of the Centennial, was not represented by anything worthy to be mentioned in comparison, and though Germany exhibited a fine column of steel rails and the peerless Krupp products, these latter were housed in the Krupp building by themselves.

So far as this part of the fair was designed as a means of instructing the public, its value was much less than that of the corresponding department of the earlier exposition. While it is not claimed that there may not have been sections in which the display at the Columbian fair was superior to that of 1876 in other respects than in mere size, the writer firmly believes that the earlier fair was better as an educator and that its influence on American industrial progress will prove to have been more far-reaching and salutary than the stupendous spectacle just concluded.

OWL NOTES.

BY A. W. ANTHONY, SAN DIEGO, CALIFORNIA.

In a recent number of *Science* Mr. E. J. Hill gives an interesting account of capturing an owl under circumstances that might lead the reader to think that members of the owl family were dazed by sunlight. This may be the case with some owls, but I have, as yet, never fallen in with any so affected. There is no doubt that the bright glare of the sun is disagreeable to some species, but after flushing a short-eared owl and witnessing the ease with which it threads its way through tangled shrubbery, despite the sunlight, all doubts regarding their vision at such times will be set aside.

Very often, however, an owl will, in hopes of remaining unobserved, allow a person to pass remarkably near, often assuming an attitude suggestive of the knots on the limb on which it is perching.

Long-eared owls are often very averse to flying, judging from my observations. I have suddenly come upon one face to face, and sometimes several that were passing the day in a dense willow, and they immediately assumed a rigid, stick-like position, drawing themselves up to twice their natural length, evidently trusting to their resemblance to the surrounding stubs and branches, which was by no means slight. To escape notice—so great is their faith in the protection afforded them by this resemblance, when several are together, as is often the case in winter—one or more may be shot without the rest showing so much as by the movement of a feather that they are disturbed.

On one occasion a friend with whom I was hunting came upon five of these owls all in a row on a limb of a giant cottonwood. Beginning at one end of the line he shot them all, one after another, his last shot starting a sixth, which he had not seen, from a perch in the same tree. When I arrived upon the scene we began looking for the escaped owl, but failed to discover it. As we were leaving, however, my eye chanced to fall upon what, at first, appeared to be an abnormal growth on the trunk of a small sapling near us, but which, upon a second glance, proved to be a little screech-owl. With its back against the trunk of a tree it was drawn up to its fullest height, all its feathers drawn tight against its body, its ear tufts erect. It looked to be twice its normal length, and so closely did it resemble the gray bark and branches that, unprotected as it was by leaves or twigs and in the strong glare of a bright winter's day, its discovery was purely accidental. Our tracks in the snow proved that we had several times passed within ten feet of the bird, and it was quite evident that it was aware of our presence; for while it made not the slightest movement, it watched us constantly through its half-closed lids, trusting, no doubt, to escape detection, but ready to fly if the occasion required.

On another occasion, while collecting birds along the Platte River, I discovered a screech-owl in a very similar position. The morning was very cold, and *Megascops* had sought the sunny side of a small cottonwood, where, with its back against the trunk, it was enjoying the grateful warmth of the bright sun. When discovered it had assumed such an attenuated position that, although quite close, I was by no means sure that it was not a broken branch that had attracted my attention. Thinking to secure a specimen but slightly mutilated, I fired at it with dust shot, but was surprised to see not the slightest movement from the statue in gray before me. Could it be that I had been deceived after all and had fired at a knot? Half inclined to believe that such was the case, I went forward to investigate and when within fifteen feet could see that I was closely watched through narrow slits between the lids. Not a movement was made, however, until I was about to lay my hands on it, and then my owl quietly slipped around the tree and was gone. It is probable that my shot, being so fine, had not penetrated the feathers, as it was not injured in any way apparently.

I once caught a screech-owl on her nest, and while I was by no means gentle in bringing her out into the open air, she was, apparently, sound asleep, and no amount of handling would awaken her. I whistled in her ear, opened her wings and laid her down on a limb, all to no purpose. Megascops had evidently been out all night and did not propose to be disturbed by such trifles. While investigating the contents of the nest she was allowed to lie on a branch for some minutes but gave no sign of life, but I no sooner attempted to drop her to the ground than she revived. Before she had dropped a foot the wings opened, and away sailed my owl, as much awake as any bird and probably congratulating herself upon a piece of very clever acting.

—D. Van Nostrand Company, 23 Murray and 27 Warren streets, New York, design issuing the new edition of their complete catalogue of scientific books in sections, of which Parts 1 and 2 are now ready. The others are in preparation and will be issued in the order named, and copies will be sent gratis on application, as soon as issued. Part 1, Steam and Mechanical Engineering; Part 2, Electricity and Magnetism; Part 3, Chemical and Physical Science; Part 4, Civil Engineering; Part 5, Manufactures and Industrial Arts and Processes; Part 6, Geology, Mineralogy, Mining and Metallurgy; Part 7, Hydraulics and Water Supply; Part 8, Astronomy, Meteorology and Navigation; Part 9, Architecture, Building, Carpentry and Decoration; Part 10, Shipbuilding, Naval Architecture, Yacht and Boat Sailing and Building; 11, Drawing, Painting, and Photography; 12, Mathematics.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as a proof of good faith.
On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.
The Editor will be glad to publish any queries consonant with the character of the journal.

Native Calendar of Central America and Mexico.

In his recent work on this calendar, Dr. Brinton, referring to the mathematical basis on which it is founded, makes the following statement :

"An ingenious theory of the mathematical development of this calendar has been offered by Mrs. Zelia Nuttall. It assumes that at the close of each period of $20 \times 13 = 260$ days, 5 intercalary days were inserted before the next 260-day period was technically commenced. This naturally brought its commencement on the next subsequent Dominical day, and also caused the whole period, 265 days, to equal, very nearly, nine lunations. If it can be shown that the intercalation actually took place, Mrs. Nuttall's suggestion will have cleared up one of the most obscure problems in American archæology."

If I rightly understand the author, there appears to be in this a misconception of the relation of the 260-day period to the solar or ordinary year. If these periods followed one another with intervals of only five days, they could not possibly bear any fixed or determinate relation to the ordinary years. Now I have always supposed, and, from all the evidence I have been able to obtain upon the subject, still believe, that each ordinary year *included* one sacred period, or "vague solar year," as Dr. Brinton terms it. Mr. Cushing informs us that this is beyond question the idea entertained by the Zuñis in reference to their time systems, or, as he expresses it, the sacred period, embracing some eight or nine months of each year, "is the kernel of the ordinary year," being governed, however, as to its commencement and ending by the phases of the moon.

It will also be observed that the same idea appears to be indicated by the time series of the Mexican Codices (as, for example, that on plates 31–38 Borgian Codex). These, we see, are bordered above and below by a line of symbolic figures which we may justly assume—as there are 52 in each line (104 in all)—represent the remaining days of the year—lacking one. As they exactly fill the divisions of the space, we may suppose this was the reason one was omitted, or there may be some other explanation. In other words, I believe the scheme of the plates indicates that the sacred period was *included* in the secular year; or, to reverse it, that each ordinary year included one sacred period of 260 days. If Mrs. Nuttall had said "105 days were added," there would be complete agreement. This sacred period, being, in all probability, regulated to some extent by the moon, would shift somewhat its time of beginning and ending.

I may add here (but expect to present the reasons therefor more fully in a future paper) that there are substantial reasons for believing that we must look beyond the boundaries of our continent for the origin of this calendar. The flower, when we first find it here, is too fully blown to suppose it thus came into existence; there must have been a bud and germ somewhere. These have not as yet been found in other American tribes.

I think we may assume that the natural basis was the revolution and phases of the moon; the mathematical basis the count of the fingers and toes, beginning with five; and that the mystical reference to the cardinal points also entered into its formation. As indicating the line of research most likely to lead to satisfactory results, I refer to the following facts :

According to Mr. Cushing, a particular color was assigned by the Zuñis (as by many other peoples) to the cardinal points, but to the focus or centre a *mixture* of colors, or, in other words, it was said to be "speckled." It is a singular fact that in the old "native" Javanese calendar the week cousisted of five days, each having a particular name. These were supposed to have a mystical relation to certain colors and to the cardinal points. "According to this whimsical interpretation," remarks Crawfurd ("Indian Archipelago"), "the first means white, and the east ; the second red, and the south ; the third yellow, and the west ; the fourth black, and the north; and the fifth *mixed color*, and the *focus* or centre." Let us suppose this, as it is so far away, to be accidental.

According to Judge Fornander ("Polynesian Race"), the Hawaiians formerly counted twelve months, of thirty days each, to the year, and added five days at the end of the last month—*Welehu*—to make up the 365, these being "tabu-days." Each month and each of the thirty days of the month had a particular name. He also adds that they had two modes of reckoning time, one by lunar cycles, whereby the monthly feasts were regulated; and the other the sidereal year, which appears to have been regulated by the rising of the Pleiades. He also adds the further important information that the feasts, or Kapu-days, were observed *only during eight months* of the year. This period corresponds somewhat closely with the sacred period of the Central American and Mexican calendar, and also with the sacred period of the Zuñis.

Mr. Dibble, in his "History of the Sandwich Islands" (Edn. 1843), gives some additional particulars, which, though somewhat confused from want of a thorough knowledge of the system, have a strong bearing on the question of the origin of the Mexican calendar. He says the Hawaiians divide the year into two seasons of six months each; that the year consisted of twelve months. He adds further that "In one year there were *nine times forty nights*." Here we find the nine-day series introduced corresponding with the puzzling nine "Lords of the Night" of the Mexican calendar. This coincidence is remarkable. As the change from nine to eighteen and from forty to twenty was simple, we may find herein an explanation of the eighteen months and twenty days of the calendar. "These nights," says Mr. Dibble, "were counted by the moon. There were thirty nights in each month, *seventeen of which were not very light and thirteen were*." These numbers are very significant in this connection. Yet it is apparent that the author, not understanding the system, gives but fragments. In his attempt further on to explain the revolution of the count by the moon and the sidereal year, this confusion becomes more evident and is partially, though not fully, corrected by Judge Fornander. But enough is given to show that the two periods, the sacred and the secular, were in use, and that the system was very similar in its unusual features to that in use among the Mexicans and Central Americans.

Cyrus Thomas.

Washington, D. C.

Raining Worms and Frogs.

While reading the letter of a correspondent in the issue of January 7, on "Does It Rain Worms?" I was reminded of Thomas Cooper's statement in his autobiography that he *saw* it rain frogs when he was a boy.

A waterspout on the Yellow River in China will sometimes pour down till it makes the river seem to boil in fury, and then all is reversed, the water in immense quantity is drawn up with the fish, sticks, straws—and even the loose stones from the river bed—and carried along the sky until the wind drops, and then the fish, frogs, etc., fall down, and people are astonished at the marvel. Probably the frogs seen by Mr. Cooper may be accounted for in this way. Francis Huberty James.

Boston, January 18, 1894.

Frost Plants.

PROFESSOR MCDOUGAL'S article in *Science* for Dec. 29, 1893, and especially Professor Atkinson's notes in the *Botanical Gazette* for January, 1894 (p. 40), prompt me to record another fact tending likewise to show how hard it is to make an absolutely new observation in science, and how slightly what are afterwards found to be interesting facts of science are apt to impress us when first discovered. I was driving one day last summer through the section where Mr. Mason and I had seen the frost flowers of *Cunila* in company with Mr. William Hunter, now of the National Zoölogical Park, but who was reared in that country, and has recently become thoroughly acquainted with its flora, furnishing me from there a large number of additions to my flora of Washington and vicinity. As we passed the spot I pointed it out to him and told him there was where we saw the frost-freaks. With perfect naïveté he replied that he had been familiar with them all his life, having played with them when a school-boy at the village of Accotink, hard by! LESTER F. WARD.

Coral Reef Formation.

I HAVE just seen Dr. Le Conte's note concerning "Coral Reef Formation" in *Science* for Dec. 8, p. 318.

I am sure that all who are interested in the study of coral formations will be grateful to Dr. Le Conte for calling attention to his paper, which is of much importance. In my search for whatever had been written on the subject I intended to be thorough, but I wholly overlooked the paper referred to. I greatly regret that this is so, for not only does the oversight leave my account incomplete, but does, although quite unintentionally, injustice to one whom all scientists delight to honor, and I am very glad that Dr. Le Conte did not allow the matter to pass unnoticed. I hope that any who may read my paper in *Science* for October 20 will also add the note in *Science* for December 8. GEORGE H. PERKINS.

University of Vermont, Dec. 27, 1893.

Earthquakes in the San Juan Mountains.

ABOUT midnight the morning of Jan 1 an earthquake shock was felt at Silverton, Red Mountain, Ouray, and other points in the San Juan Mountains. Another came at half-past one, another at three, another at four, and again at half-past seven. No clocks were stopped, and the times are only known approximately. Windows and dishes rattled, walls and roofs creaked, a sound as of a team rushing over the snow was heard, in one miner's cabin on the mountain a stove was overturned, and in small houses the floors distinctly trembled and reeled. Most of the shocks were accompanied by a single loud sound, as of a heavy blast—a familiar sound in these mountains. These noises were very distinct in the mines at Red Mountain up to 600 feet in depth. Similar shocks came at intervals for two days and three nights after the first. The wide extent of country over which the phenomena were substantially the same makes it probable that these shocks proceeded from some point at a distance. No one seems to have been able to perceive the direction of propagation. Did they proceed from some distant volcanic eruption? GEO. H. STONE.

Ouray, Colo., Jan. 6, 1894.

An Explanation of the Rope of Maggots.

THE "Rope of Maggots" which Mr. Jones described in *Science* of December 29 was due to the larvæ of a fly belonging to the genus *Sciara*, of the family *Mycetophilidae*, a genus which includes many species. The phenomenon, while it has been but seldom observed in America, has been long known in Europe, especially in connection with the larvæ of *Sciara militaris*, which derives its specific name from this peculiar habit. The maggots are known as the "Heerwuerme" or, in English, the "army worms." We have several species in America which are closely allied to *S. militaris*, and it is perhaps the larvæ of some one of these species which formed the "rope" in the case mentioned. I have never seen any reason given why the larvæ congregate and travel in this way. They do not feed on carrion. S. W. WILLISTON.

Petrified Eyes.

Is it known that the crystalline lens of the eye has ever been petrified in homogeneous quartz? I have never seen or heard of such a thing except in a popular school geology, and do not believe the following statement, which is taken from the book:

"A monster, some thirty feet long, with jaws nearly a fathom long, and huge saucer eyes, which have since been found *so perfect that the petrified lenses have been split off and used as magnifiers.*"

Have such lenses ever been found, or is this merely the material of which elementary science books are formed?

GEO. G. GROFF.

Lewisburg, Pa.

"Do Earth Worms Rain Down?"

IN *Science* of Jan. 5, under the above caption, Charles B. Palmer refers to the old-time notion that worms, frogs, fish, etc., rain down as one seldom mentioned by intelligent people except in the way of ridicule. That this notion is yet entertained by many will appear from what follows. A few days ago I presented this subject to a class pursuing the study of zoölogy, and several stated they had found fish and frogs after a rain on land where before no water could be found. A young man, of undisputed intelligence, declared that about two years ago, in this city, children on their way to school picked up fish as they fell on the sidewalk in a rain storm and brought them to the school where he was in attendance.

On Jan. 20 a wind unusually heavy for this section prevailed in Nashville. Rain fell abundantly in the latter part of the day. In the evening seven young men were standing under the awning of a certain store when they heard a sudden splash, mud and water being thrown on one of the boys and upon the corner post of the awning. Their attention was directed to a living creature about five feet from the pavement, which they succeeded in capturing. The specimen was brought to me for indentification and proved to be a full grown sword-shaped salamander (*Amblystoma xiphias*), measuring ten and three-fourths inches in length. Upon questioning the young men I obtained the following testimony: They did not see it falling; they did not see it in the air; they heard the splash; in falling it buried itself in the mud and water; they were fully persuaded that it had rained down.

The following day I observed earthworms on the brick pavement. This fact and the occurrence of the above species in mid-winter away from winter quarters, together with the facts that butterflies, moths and grasshoppers were seen on the wing on Christmas Day, that a butterfly (*Agraulis vanillae*) emerged on Jan. 15 in a breeding cage which had been kept in a cool room, that the pupa has been spending the winter with us, and that such flowers as the ground ivy and dandelion have been in bloom, will suggest the mildness of the winter we have experienced up to the middle of January. WM. OSBURN.

Nashville, Tenn., Feb. 1, 1894.

The Mystery of Worms in Rain.

THE mysterious appearance of earth worms at certain times and places mentioned by Mr. Charles B. Palmer in *Science*, No. 570, is easily explained, it seems to me, by close observation of the worms under favorable conditions. Several of his queries are answered more or less directly by the following quotation from the manuscript of a little book on animal studies which I prepared saveral years ago, but which was never published:

"The time was in May during very rainy weather. The best place for observation was a portion of the lawn over which earth had recently been spread several inches deep. The bare ground of a garden which had not been disturbed since last year was almost as good.

"On going out in the early evening, a constant slight snapping sound could be heard proceeding from the ground. Moving carefully, in order not to jar the ground and frighten the worms, a spot was selected for observation.

"Looking closely, a dozen or more worms could be seen on each square foot of ground; some extended nearly full length on the surface, others protruding but an inch or so of the head. All were constantly moving the head about as if searching for something. Next morning several holes were found with blades of grass drawn partly in.

"A two-gallon jar was nearly filled with moist earth and placed in the house, where a lamp could be used for observation at night. Some worms were put in and a few blades of grass placed on the earth. All the worms kept below the surface during the day, but in the evening were always active at the surface.

"One evening after a rain a worm was noticed crawling on the second step of the porch. A few minutes later it was crawling along the *under* side of the projection of the third step and was soon over on the top investigating things to its satisfaction."

Under ordinary conditions the worms remain concealed in their burrows during the day, but they habitually come to the surface at night, as is well known. That they immediately seek to penetrate the earth on being dug up necessarily follows from their extreme wariness, which prompts them to retreat at the least sign of danger. When they come to the surface "to be pelted by the rain" I have no doubt that they are accepting the lesser of two evils by escaping a deluge underground. Having seen a worm crawl comfortably along the under side of a painted board, I see no reason why it should not reach the roof and go down the conductor to the cistern. Nor does its climbing powers seem remarkable when we consider the moist, clinging body, and the peculiar organs of locomotion.

This does not disprove the "rain down" theory, but only shows that, so far as earth worms are concerned, the phenomenon may have a more reasonable explanation. As to the sudden appearance of frogs after a shower, it is stated that this is a common occurrence in certain tropical countries, where the excessive heat and dryness drive them to seek shelter under leaves and earth till the cooling rain calls them out. In the month of August I have found live water beetles of the family *Hydrophyllidæ* buried deeply in swamp earth, where they had retreated probably two months before when the last drop of water evaporated. The remarkable degree of adjustment to the evironment, which permits most animals of the lower orders to remain for a long time in a state of suspended activity, will doubtless explain most of these mysterious apparitions when all the conditions are known. C. D. MCLOUTH.

Muskegon, Mich., Jan. 20, 1894.

BOOK REVIEWS.

An Elementary Treatise on Theoretical Mechanics. By ALEX. ZIWET. New York and London, Macmillan and Co. 1893, two vols.; 8vo, pp. 181, 175.

THE two volumes here mentioned contain, the one the outlines of kinematics, the other those of statics. A third volume, to include the treatment of dynamics, is promised later. The author, Professor Ziwet, of the University of Michigan, has sought to secure a good text-book in pure mechanics, especially well adapted to the student in the higher class of American colleges. The European method of study of the mathematics is stated to be the presentation of the science of mechanics before taking up the higher mathematics and its review after a later study of the calculus and other advanced mathematical studies. In this country it is more usual to study mechanics only after the course of higher mathematics has been taken. The work is intended as an introduction to the science of theoretical mechanics; but is also expected to prove useful to engineering students preparing for work in applied mechanics and related subjects. Theories are illustrated by special problems, and sets of exercises are introduced to be worked out by the student. Good care has been taken to make the references full and amply numerous to facilitate later or collateral reading.

The treatise on kinematics is one of the best which has been yet presented and gives an excellent presentation of this comparatively recent, and, as yet, incompletely developed, science. It is based on Reuleaux and other German writers mainly, and is one of the most systematic and continuous discussions of the subject which has appeared in English. The subject of statics is well planned, well written and well carried out in detail. The whole work is evidentally the product of one familiar with his subject and capable of giving his work the form which experience has shown him to be desirable. The book-making is excellent. The paper and press-work are admirable, and the two volumes are most creditable to both author and publisher.

A System of Easy Lettering. By J. H. CROMWELL. New York, Spon and Chamberlain, 1893, 27 p., 12mo, $0.50.

THIS little book is full of excellent illustrations of the most simple, as well as the most complicated and most graceful, forms of draughtsman's letters, arranged and proportioned especially for his use. The scheme is simply as stated in the preface: "We have but to divide any surface we may wish to letter into squares (or parallelograms, as the case may be) in pencil lines; form the required letters, in ink or paint, and, according to the style chosen, erase the pencil lines, and the lettering is complete." The selections are good, the work is excellent and the make-up of the book all that could be desired.

Steam Machinery and the Marine Engine. By J. LANGMAID and H. GAISFORD, of the Royal Navy. London and New York, Macmillan & Co. 1893, 8vo, xv., 267 p. New edition, revised and enlarged.

THESE elementary lessons in steam marine machinery are prepared for the use of the naval cadets of the British navy, and are introductory to more formal and mathematical studies. They include a purely descriptive account of the details of machinery, prefaced by chapters on the forms and uses of drawing instruments, statements of the properties of the materials of engineering construction, and of the various forms of joints and fastenings, such as riveting and bolting. The book is very exceptionally well-illustrated, and all the important engravings are made to a stated scale, so that it is easy to ascertain

the dimensions, as well as the proportions, of the parts represented. The different shapes adopted for shafts of marine engines and their accessories, cranks and rods, eccentrics and cams; toothed gearing of all usual kinds; stuffing boxes and joints; valves and cocks and pumps, and other minor parts, are all well-described and finely illustrated before the construction of engines and boilers is studied in larger plans.

Drawings and descriptive text exhibit the forms and proportions of the modern marine boiler and of all its appurtenances; while in this connection, the fuels and their composition, the properties of steam, and the economics of steam-making, are presented in a simple manner. Similar methods are adopted in the treatment of the marine engine, and the most recent types are fully described.

No attempt is made to give the mathematical principles involved in construction, or to teach the art of designing and proportioning the engine, the boiler, and their accessories. The book has little value to the engineer; but, as an introduction to the serious study of the steam-engine for marine purposes, it is admirable. The authors and publishers have done their work well, and we have rarely seen a finer piece of technical book-making. Paper, press-work, and binding are good, and its illustrations among the very best that we have ever seen in this department of literature.

NOTES AND NEWS.

Mr. Henry C. Mercer, the newly appointed Curator of American and Prehistoric Archæology at the Museum of the University, delivered an address on "The Human and Animal Remains in the Lookout and Nickajack Caves at Chattanooga, Tenn.," before the Numismatic and Antiquarian Society of Philadelphia, on the evening of Jan. 4. Mr. Mercer referred to the importance of cave explorations in European archæology, and stated that the one fact that we gather is that early man dwelt in caves. Little cave hunting has been done in this country, chiefly because American archæologists have gone wild over "relics," and mounds and cliff dwellings had diverted attention from other explorations. The speaker reviewed the work done in examining caves in this country, such as the investigations made by Professor Rogers at Durham Cave and Haldeman at Chikies, as well as the Port Kennedy "bone hole" explored by Professor Cope. A great scantiness of animal remains as compared with similar caves in Europe characterizes American caves, and this is accounted for by the difference in the conditions. The Lookout Cave at Chattanooga he regarded as typical. The floor of the cave, like that of many of the other caves in its vicinity, had been disturbed during the War of the Rebellion by workmen engaged in digging nitrous earth for the manufacture of gunpowder. He talked with the men who had been engaged in this work, and learned from them the portion of the floor which they had not disturbed. The bottom of the cave contained a mass of human and animal refuse. The floor was divided into sections by the explorer, and each fragment of bone, pottery, or stone was marked with the number of the section, and a number indicating the depth; so that things found in the first foot of digging were marked "one"; in the second, "two," etc. This work was carried down a depth of about four feet to the bottom of the animal deposits, and the contents appeared entirely homogeneous. The remains were Indian throughout, and decorated pottery was found in the lowest part. No indication of palæolithic man, nor of pygmies, nor of any one except the familiar Indian was discovered. The bones and shells have been identified by Prof. E. D. Cope, and reveal the following fauna: Deer, opossum, lynx, squirrel, rabbit, bat, peccary, raccoon, marmot, water tortoise, soft-shelled tortoise, sucker, garfish, spadefoot

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toad, tapir. Of shells, two species of Io, seven of Unio, two of Paludina and Trypanostoma were found. Most important of all, in the opinion of the explorer, were remains of the peccary, and tapir. Teeth of the latter, the speaker stated, were found so near the bottom of the deposit that they may have belonged to the lower alluvial strata, and not to the period of the human remains. In the discussion on the paper President Brinton stated that the tapir was commonly regarded as a South American animal, but that within our century it had been observed as far north as the Isthmus of Teotehuntepec, and that it was not necessary to take refuge in the theory that the teeth of the tapir belonged to the lowest strata, as it is not unlikely that the tapir existed in the Gulf States within a comparatively recent time. Mr. Mercer gave an account of an Indian ossuary that he found in a rift in the Lookout Cave, and exhibited specimens of charred femurs and the fragment of a pierced gorget, with stone arrow points from this deposit. In conclusion, he urged the importance of a thorough exploration of the caves of the entire country as likely to settle the question of early man in America. Dr. Brinton did not think the absence of objects of a primitive type in caves as conclusive with reference to the absence of primitive man. Early man was probably arboreal, and did not live in caves at all. According to the best French archæologists, the man of the river drift was older than the cave man, and his bones are associated with remains of a fauna that required a tropical climate for their development. The fossil remains from the explorations were exhibited at the close of the meeting.

—It is with deepest regret that we announce the destruction by fire of the new Engineering Laboratory at Purdue University, LaFayette, Ind. It was burned on the night of Jan. 23—four days after its dedication. The fire originated in the boiler room and spread with great rapidity. Its progress could not be checked until the larger part of a fine building had been destroyed. Three laboratory rooms were burned; the machine room with its twenty lathes, its planers, shapers, drill presses, milling machines, and its large supply of small tools; the forge room with its thirty-two power forges; and the laboratory for advanced work, which contains Purdue's now famous locomotive "Schenectady," a triple expansion Corliss engine and much other apparatus designed for work in steam engineering, hydraulics, and strength of materials. Nothing in these rooms escaped the fire. Not only was all the apparatus lost but also a large amount of experimental data. The main portion of the building was also consumed. This contained three stories, 50 feet by 150 feet. It was occupied by drawing rooms, recitation and lecture rooms, instrument rooms, offices and a mechanical museum. Some of the furniture and apparatus in these rooms was carried out before the fire took possession, but, as already stated, this part of the building was entirely burned. The only portion still standing comprises the wood room and foundry. These rooms were not damaged except by the temporary removal of the more portable portion of their equipment. The incidental losses by the fire are considerable. Members of the faculty have lost books, papers and data; students, their instruments, and manufacturers, in every part of the country, who, by gifts or liberal discounts, had coöperated in the equipment of the building, have lost their representation there. The excellent facilities for laboratory training which Purdue has been able to offer have made her engineering departments well known and have helped to draw to them a large number of students. It is hoped and expected that the new building will be quite as extensive and its equipment quite as complete as were the building and equipment which have been lost, and, since experience has suggested the modification of many details, it is but reasonable to expect the second plant to be better than the first.

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CONTENTS.

CHARLES BONNET'S IDEA OF THE DEVELOPMENT OF THE CHICK 72
VACCINATION. J. N. Hall 72
THE MESABI IRON RANGE. E. P. Jennings . . 73
PETROLEUM IN SOUTHERN CALIFORNIA. S. F. Peckham 74
INTERPRETATION OF MAYA GLYPHS BY THEIR PHONETIC ELEMENTS.—Part II. Hilborne T. Cresson. 76
NOTES ON THE GENUS STROMATOCERIUM. Henry M. Seely 78
DR. CALLAWAY AND THE PRODUCTION OF CRYSTALLINE SCHISTS BY DYNAMO-METAMORPHISM. J. W. Redway 79
MEMORABILIA BOTANICA, I. Erwin F. Smith . . 80
CURRENT NOTES ON ANTHROPOLOGY.—No. XXXIX. Edited by D. G. Brinton 81
LETTERS TO THE EDITOR:
CATS HUNTING SNAKES. D. S. Martin . . 83
THE AMERICAN BOX TORTOISE. W. E. Taylor . 83

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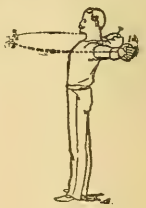

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SCIENCE

NEW YORK, FEBRUARY 9, 1894.

We regret the delay in the issuing of *Science*, which is due to its taking longer to install The Science Press than was expected. Now that the new office is in working order we hope to make up for lost time.

CHARLES BONNET'S IDEA OF THE DEVELOPMENT OF THE CHICK.

Charles Bonnet, the distinguished naturalist, was born in Geneva in 1720 and died in 1793. He worked assiduously with microscope and lens and devised many new experiments on plants and animals. He was a friend of Haller's and stoutly maintained the latter's doctrine that all the vital functions could be reduced to two—sensibility and irritability. His first important work was the investigation of the life history of aphides, and his interpretation of partheñogenesis was a great triumph to the *ovists*. The process of development in his time was considered by many to be purely a proces of unfolding of a preformed germ which contained in miniature the future animal or plant. But the supporters of his idea were divided into two camps: the *animalculists* held that the miniature animal—the germ—was carried in the male seminal fluid to the proper matrix, where it found suitable nourishment and grew—*i.e.*, unfolded. The *ovists*, on the other hand, maintained that the germ existed in female and explained fecundation as a stimulus produced by the male fluid which furnished the first nourishment of the tiny germ. The fact, then, that a female aphide could produce offspring without coupling with a male seemed to give the ovists a convincing argument.

His works are interesting reading to-day, for he was not only a keen observer but a careful writer as well. To be sure, his facts are often meagre, and often the results of his or his contemporaries' observations were insufficient to base the broad generalities upon in which he delighted; yet within the knowledge that he had he argued well. Who knows but what the student of a hundred years hence may smile at Weissman's conclusions as we do at Bonnet's? In the following description of the development of the chick the reader should always keep this in mind and should as far as possible forget for the time much of the detail that has become known to us since improved microscopes and sections have been in use. The selection translated below may be found in his "Contemplation de la Nature" (tome iv., pt. 1, chap. x.), published in 1764:

LA GÉNÉRATION—LE POULET.

An egg not fecund has a yolk like an unfecund egg. The goodwives have known this all the time; and there is in this little fact, so well known, so little examined and so worthy of it, something which comes to throw a flood of light and has cleared away the shadows with which the great mystery of generation has been enveloped.

Give all your attention to this: you are going to put your finger on an important verity. A membrane invests the yolk internally, and this membrane, which is only the continuation of that which covers the small intestine of the chick, is common to the stomach, the pharynx, the mouth, to the skin and epidermis. Another membrane invests the yolk externally, and this membrane is only the continuation of that which covers the intestine: this unites with the mesentery and peritoneum. The arteries and veins which course through the yolk derive their origin from the mesenteric arteries and veins of the embryo. The blood which circulates in the yolk receives from the heart the impulse of its motion.

The yolk is, then, essentially, an appendage of the intestine of the embryo, and together they form an organic whole. Therefore, in earliest times, the chick is, to some degree, an animal with two bodies: the head, trunk and the extremities compose one of these bodies; the intestines and the yolk form the other. At the end of incubation the second body is pushed within the first, and the two make but the one.

But since the yolk exists in eggs which have not been fecundated, it follows necessarily that the germ is pre-existent to fecundation. This consequence stares one in the eyes: you come to see that the yolk is an essential part of the chick. You recognize the direct connection between the one and the other. The chick has not existed, then, without it. The membranes and vessels of it are only a continuation of those of itself. And how many other things there are which they have in common, which prove that they have never existed separately. The chick was, then, entirely in the egg before the fecundation. Then it owes not its origin to the liquor which the cock furnishes: it was defined *en petite* in the egg, prior to the commerce of the sexes. The germ, therefore, pertains exclusively to the female.

The evolution or development proceeds by nutrition; you have seen it. Nutrition supposes circulation; you have seen it also. Finally you have seen that the heart is the seat of circulation. If it does make a circulation in the germ before fecundation you will admit at least that it is not sufficient to perform the whole evolution which will render the germ visible, and which gives to all its parts, the form, proportions and arrangement which characterize the species.

The germ cannot achieve its development in an egg which has not been fecundated, and incubation will only hasten its corruption. Yet what does it lack in order to continue to grow? It has all the organs necessary to evolution. It has taken on itself a certain increase, for eggs increase in virgin pullets; their ovaries contain them in various sizes. The germ may grow, then. Why can it not develop completely? What secret force holds it back in the limits of invisibility?

Growth depends upon the impulse of the heart. A great growth depends upon a great impulse. The heart of the germ which is not fecundated lacks this impulse.

This demonstrates a certain resistance in the parts of the germ. In measure as it grows, this resistance in-

creases. Some parts resist more than others; the osseous parts more than the membranous.

The heart of the germ, then, needs a force proportioned to overcome this resistance. Its force is in its *irritability*, or in the power to contract when brought into contact with a liquid. Augment this irritability, and you augment its impulsive force.

Fecundation increases, without doubt, this force, and it alone can do that: since it is only by its intervention that the germ succeeds in freeing itself from the narrow limits which restrained it in its first stage.

The fecundating liquor is, then, a true stimulant, which, carried to the heart of the germ, excites it powerfully and communicates to it a new activity. This is what we call *conception*. Movement once impressed on this little prime mover is conserved by the unique energy of its admirable mechanism.

But it does not suffice that the heart acquire a force capable of overcoming the resistance of solids: the fluid which it sends them for nourishment must be proportioned to the marvelous fineness of the vessels. A blood such as ours would not circulate. The blood of the embryo at first is a whitish liquid; it turns yellow by degrees and finally becomes red. The impulse of the heart dilates the vessels more, and they admit larger particles, heterogeneous and colored.

The generative liquor is not, therefore, a simple stimulant: it is besides a nourishing fluid, appropriate to the extreme delicacy of the parts of the germ. It fulfilled already in the body of the fertilizing individual the functions of a nutritive fluid: it made the comb and spurs grow and gave strength to all parts. You recall the degeneracy of the capon, and how it differs from the cock. You might have many more proofs that the generating fluid is the first aliment of the germ.

Transported by the arteries to all the parts, it unites with them in a fixed manner, according to the proper nature of each. The chick is not slow to lose its form of tadpole. Wings, legs and feet proceed out of the long tail; everything comes out, fashions itself and arranges itself on a new model. The little animal, stretched out at first in an almost straight line, curves itself more and more. It invests itself more and more with muscles, tendons, bones and feathers, and in 18 or 20 days it is a perfect chick. B.

VACCINATION.

BY J. N. HALL, M.D., DENVER, COLO.

In view of the periodical crusades againt compulsory vaccination by certain enthusiasts opposed to the practice, I have thought that it might be of interest to the readers of *Science* to look at a few of the results to be deduced from recent statistics upon the subject. The reason why no thoroughly scientific study of the anti-vaccination side of the matter has been made would seem to lie in the fact that no scientific mind could view the situation in a judicial way without seing that all of the facts are upon one side, and that the one of the advocates of vaccination. With this prelude I will allow the facts to speak for themselves.

In 1874 the compulsory re-vaccination law became operative in Prussia. (See Dr. Sykes's "Public Health Problems," London). By its provisions, every infant must be re-vaccinated, and every scholar in public and private schools must be re-vaccinated at the age of twelve years. If we take the average number of deaths from small pox per 100,000 living in Prussia, we find that for the five years preceding the introduction of compulsory vaccination the number was 113+. Since the law went into effect, in but one year, up to 1883, has it reached 4 per 100,000. The average is much less. I have not at hand the figures since that time, for the whole population, but in the Prussian army, where all the conditions are under better control, the results are so much better that I will quote them. This is easily done, for with the exception of a single death in 1885, the name small pox has not appeared as a cause of death in the annual reports since the law went into effect. It should be borne in mind in this connection that Prussia is constantly exposed upon its Russian and Austrian borders to the disease.

As to the death rate in vaccinated and unvaccinated persons, we may quote the conclusions of Dr. Barry, in his report of the epidemic of 1887-8, in Sheffield, England. Without quoting the figures, it will suffice to present the statement that "the children vaccinated, had, as compared with the unvaccinated, a 20-fold immunity from attack, and a 480-fold security against death from small pox; the persons over ten years of age, once vaccinated, had a 5-fold immunity against attack, and a 51-fold security against death; and the twice vaccinated, a 31-fold immunity from attack, and a 640-fold security against death."

Inasmuch as the objections to vaccination on the ground that syphilis and leprosy may be transmitted may be completely done away with by the use of heifer-virus, we need not discuss the matter. There is, indeed, a certain element of danger in vaccination, as in every other thing of established value, but it is strange that in the face of such evidence as may be obtained from scores of reports of boards of health, medical departments of armies, etc., etc., there are still found those who deny the value of the most beneficent discovery ever made by man. There is good reason for hoping that we may soon be able to control in similar manner many other of the contagious diseases which have in the past made such havoc with our race.

—"The Political Economy of Natural Law," by Henry Wood, which appears from the press of Lee & Shepard, of Boston, is virtually an enlargement of a work published seven years ago under the title, "Natural Law in the Business World." The author's main thesis, that all industrial operations are governed by natural law, is of course nothing new, nor is his presentation of it more scientific than that of the regular economists, but less so; yet there is much in his book that may be useful if it reaches the right class of readers. Those who wish a thorough and scientific formulation of the known laws of economic life will prefer the regular treatises; but those who do not relish the hard study that such treatises require, and who like a more popular mode of treatment, will find in this work some useful lessons on the matters with which it deals. That the law of supply and demand cannot be set aside by artificial restraints, that combinations of laborers are often tyrannous, and combinations of capital tend to overreach themselves, and that socialism, if once established, would carry within itself the seeds of its own dissolution, though familiar truths to well-informed men, are not so widely known in the business world as they ought to be; and Mr. Wood's statement of them may attract readers who would never read the elaborate works of Mill and his successors. Mr. Wood takes extreme ground against legislation on business matters, but makes an exception in favor of the protective tariff, which seems to be a pet measure of his. On the whole, however, he is open-minded and fair, and his opinions in the main are such as the best economists will approve.

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THE MESABI IRON RANGE.

BY E. P. JENNINGS, IRONWOOD, MICH.

THE discovery and development of this new source of iron ore within the last two years presents many points of interest. The deposits differ from all others in the Lake Superior district in being horizontal, and are only covered by the glacial drift.

The range is situated about 50 miles north of Lake Superior and extends from the Canadian line west to, and probably beyond, the Mississippi River, a distance of about 140 miles. The ore bearing belt is narrow, averaging about one mile in width.

The beds lie on the south flank of the Giant's Range—a chain of granite hills which form the watershed between Lake Superior and Hudson's Bay.

The rock series, according to Professor N. H. Winchell, is as follows:

First. The Archæan granite of the Giant's Range.

Second. Green Schists of the Keewatin-Archæan, dipping at high angles to the south.

Third. Quartzite, unconformable on first and second Taconic.

Fourth. Iron ore and taconite horizon Taconic.

Fifth. Slates and cherts—Taconic.

Sixth. Black slates—Taconic.

Seventh. The gabbro overflow which covers the eastern third of the range, and also appears to the south of the central part of the range.

Small bodies of banded titaniferous ore occur in the gabbro, but these deposits have no value and belong to a different horizon from the vast deposits of the so-called taconite horizon.

The taconite is a grayish, jaspery quartzite, enclosing narrow bands and masses of ore, and is somewhat similar in character to the banded jaspery ores of the Michigan Ranges. Where the conditions have been favorable the ore bodies have been formed by the solution and removal of the silicious rock through the agency of carbonated waters. The iron oxides, being insoluble in this reagent, have been left in various states of aggregation from hard specular and massive hematites to soft hydrated oxides.

The conditions favorable to the solution and removal of the silicious matter from the taconite or banded ore appear to be, first, that the taconite must not have been covered by other rock that would have preserved it from the action of the carbonated waters. So far no ore has been found in the taconite when covered with the black slates. Second, that a free drainage to these waters was essential; when some barrier was interposed,—as, for instance, the green schists of No. 2 of the series, which in some cases cuts through the taconite, and so prevented the flow of the water saturated with silica,—no enrichment of the lean strata took place.

The quartzite under the taconite has also been acted upon by the carbonated water, for the layers immediately under the ore are disintegrated and have the appearance of a soft white or yellowish sand. Slight streaks of the same sand are also found in the ore, showing that in places the action of the water has not been complete.

About all the known ores of iron are found in these deposits, with the exception of carbonate, such as hard specular, massive hematite, soft blue black hematite, limonite, göthite and some magnetite. The latter can be separated by a magnet from the soft blue hematite. There is little or no pyrite in the ore, and in general the sulphur compounds are absent. The best ore is the so-called "blue" ore, a fine granular blue black hematite, which does not soil the hands as most of the soft ores do. This ore carries from 62 to 68 per cent iron, and phosphorus from .007 to .050 per cent, with small amounts of silica, lime, magnesia, and alumina, and is an ideal blast furnace ore.

Some of the ore basins are very large and show that the concentrating process has been on a very extensive scale. The basin at the Biwabec is about 3,000 feet in length by about 1,000 feet in width, with a depth along the axis of the deposit of 100 feet or more, the deposit gradually thinning out on the northern edge near the granite. This deposit is known to contain 20,000,000 tons of blue ore and possibly as much more of the yellow and brown ores that will run 60 per cent in iron. This is but one of many known basins.

The ore in these beds is nearly horizontal and varies from a few feet to over one hundred feet in thickness and is covered by the glacial drift from a few inches to one hundred feet in depth.

The operation of mining consists of first removing the "over-burden," which is done by steam shovels. Then railroad tracks are laid on this uncovered surface of the ore. The ore is loosened by light blasts of black powder and shoveled and hoisted on cars by steam shovels. Two thousand eight hundred tons of ore have been mined and loaded with a single shovel in a day of twenty hours.

The great hoisting and pumping engines of the deep mines of other districts are here replaced by the tools of a modern railroad contractor—the locomotive and steam shovel. As there is no pumping, no hoisting, no timbering, and as most of the work is done by machinery, no skilled miners are required and few men of any kind. The cost of mining is therefore very low.

Considering both the quality and quantity of ore and low cost of production, this new range is certainly one of the most wonderful discoveries of the century.

—Mr. Goldwin Smith in the preface to his latest book, "Oxford and her Colleges: A View from the Radcliffe," says: "The writer has seldom enjoyed himself more than in showing an American friend over Oxford. He has felt something of the same enjoyment in preparing, with the hope of interesting some American visitors, this outline of the history of the University and her colleges. He would gladly believe that Oxford and Cambridge having now, by emancipation and reform, been reunited to the nation, may also be reunited to the race; and that to them, not less than to the universities of Germany, the eyes of Americans desirous of studying at an European as well as at an American university may henceforth be turned."

PETROLEUM IN SOUTHERN CALIFORNIA.

BY S. F. PECKHAM, UNIVERSITY OF MICHIGAN.

THE history of the development of petroleum in Southern California is very interesting. It first attracted attention just at the close of the war, when the energies of the country were again directed to the development of its material resources. The production of oil upon Oil Creek, Pennsylvania, had assumed such proportions as to stimulate effort in all directions for the opening up of every locality, not only in the United States, but in foreign countries where springs of petroleum or deposits of other forms of bitumen encouraged the possibility of repeating the experiences that had attended the drilling of wells along the tributaries of the Upper Alleghany.

Among the persons who had promoted the enterprises that had borne such fruit on Oil Creek none had been more prominent than Professor Benjamin Silliman, Jr., and his contributions to the scientific press upon the oil springs of Pennsylvania soon became classical. It is not surprising, therefore, that when he announced that a duplicate of the oil region of western Pennsylvania existed in the region south of Point Conception and the coast ranges his utterances were accepted as oracular and that commercial enterprises of unlimited dimensions found the most cordial support from capital on both the Atlantic and Pacific coasts.

The insufficient examination given the subject and the shameful imposition practised upon Professor Silliman by those in whom he had a right to place confidence led to both extravagant expenditure and expectation along the whole line of development, so that the collapse of the vast organizations that during 1865–6 attempted to make real the prophecies that had been indulged respecting the possibilities of Ojai, Simi, etc., was more complete and disastrous than it ought to have been, and the reaction robbed the industry of the merit that justly was its due.

While in California in 1865–6 I became convinced that nearly all the wells that were located and drilled during that period were drilled in barren rock, hence their failure to produce oil was not surprising. The tunnels driven by Wheeler and Moss into the Sulphur Mountain and by others in the Newhall District, around the Pico Cañon, demonstrated the fact that petroleum as well as maltha existed in the mountains of this region; but the difficulties of drilling and the small returns realized in any instance, as compared with other wells, particularly in Pennsylvania, led to the most disastrous and complete discouragement for many years.

Added to this was another class of facts scarcely less discouraging. Repeated, and in many instances very costly, experiments fully established the fact that in California petroleum technologists had a new substance to deal with from which commercial articles identical with those obtained from Pennsylvania oils could not be made. The illuminating oils were small in quantity, but they were beautiful in appearance, and were only found to be different from Pennsylvania oils when they were burned; the differences having always from that time to this presented a difficulty in the way of commercial success that is fundamental. In the early days of refining, when it was taken for granted that petroleum was petroleum, wherever found, the petroleum obtained in Southern California, for the most part from tunnels, was attempted to be refined by simple distillation and treatment, as was at the time the custom in Pennsylvania. At this period (1865–6) the technology of Pennsylvania petroleum was extremely simple. Naphtha was a drug in the market and was forced into the burning oil or was burned under the stills, while, with stills being for the most part run to coke, the lubricating oils were dark in color, rank in odor and generally in ill-repute. When the attempt was made to treat California oils in the same manner, it was found that there was but little naphtha, not much more burning oil, a large proportion of an oil that was neither burning oil nor lubricating oil, and a small amount of oil dense enough and with body enough for lubrication. Wheeler came back from San Francisco, where a trial run had been made, and, in language more graphic than polite, declared that the stuff was "all d—d middlings."

Soon after Professor Silliman took a barrel of Ojai tar (maltha) to Boston and treated it in the experimental still used at the Downer Kerosene Oil Company's works. He produced a certain percentage of illuminating oil. At about the same time I succeeded by distilling the petroleums from the Canada Laga and Pico springs and from the tunnels in Wheeler's Cañon and also a specimen of maltha from the same pool on the Ojai from which Professor Silliman's barrel came, in increasing the yield of illuminating oil to a very respectable percentage. But while the illuminating oil thus produced was colorless and brilliant, it was peculiar, and could never be sold, so far as I have been informed, on its own merits in competition with illuminating oils made from Atlantic coast petroleums.

In this condition the matter rested for many years. A few barrels of oil were produced each year. Some of it was treated, but most of it, so far as I can learn, was sold crude for fuel.

About 1880 a new era dawned. Several gentlemen who had had large experience as oil producers in Pennsylvania, after a thorough study of the stratigraphy of the Sulphur Mountain and the ranges bordering the Santa Clara Valley, located a number of wells on the Ojai ranche and in the Sespé and other cañons that greatly exceeded in productiveness any wells formerly drilled in this region. The location of these wells was made on an entirely different principle from that which determined the location of wells in 1865. With few exceptions the outcrops of bitumen throughout this region are on hillsides into which the strata dip at a high angle. At the foot of these hills the maltha and asphaltum have often accumulated in extensive beds that with the accompanying rubbish sometimes amount to even thousands of tons.

The figure illustrates the situation. A careful study of the section shows conclusively that the well of 1865 might be drilled to any depth without reaching oil, while the location of 1880 presents only mechanical obstacles to the ultimate penetration of the oil-bearing strata. The problems of well-boring in this region present many difficulties. The formation is in the middle tertiary. The rocks are soft and friable and are tilted at very high angles. The wells in western Pennsylvania, after the surface water is cased off at about 300–400 feet, may be drilled to great depths as dry holes. In Southern California, on the contrary, the well must be cased to the bottom, and drilled wet, as it is impossible to case off the water. The well is first started about 12 inches in diameter and the casing driven until it can be forced no further; a second size that will just run inside the first is then inserted and driven like the first until the pressure of the yielding mass of earth and rock holds it too firmly to admit of its being driven further; when a third size is inserted, and so on until a size too small to admit of further drilling is reached. I think few wells 2000 feet deep have been drilled by this method in this region. It is obvious that the difficulties of locating and drilling wells here are very great and that in many instances a well may fail of yielding oil within a few feet of a valuable deposit.

It is but just to myself to say that I advised the superintendent of the California Petroleum Company, operating upon the Ojai ranche in 1865–6, to locate wells at the east end of the ranche, in precisely the location since de-

termined upon. The successful wells in the Torrey and Sespé cañons have since been located upon the same principle. See the figure.

It is also a fact worth noting that the tunnels driven into the Sulphur Mountain by Wheeler in 1865, the location of which I have elsewhere described, have yielded oil continuously from that time to this and are still yielding oil in moderate quantity.[1]

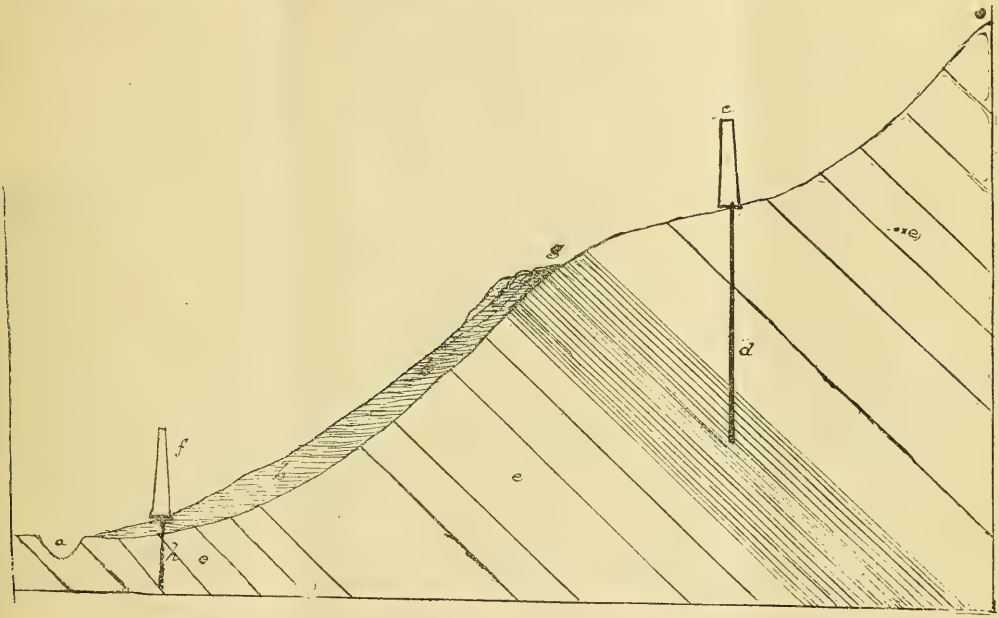
The oil having been obtained, a refinery was constructed at Santa Paula and a pail of the product manufactured into various articles for which a market could be secured. Unlike the natural oils obtained from springs, the oils from wells contained a considerable proportion of naphtha, even light enough to be suitable for use as gasoline. No illuminating oils are produced. The heavier naphthas and oils of a density suitable for illuminating oil are separated and sold without treatment as gas oil. A considerable proportion is then run off as crude lubricating oil, and the residue remaining in the still is run out and allowed to cool. This residue is a hard, brilliant, black solid. It is made for different purposes of different grades and degrees of hardness, the hardness depending upon the amount of the crude lubricating oil that is allowed to remain in the residuum. This material is a very pure (almost chemically pure) asphaltum and possesses some peculiar and very valuable properties. Straw board or wood pulp may be saturated with it and rendered nearly inert to acids and alkalies unless in concentrated solution. Straw board cut in suitable sizes may be saturated with it and made into a solid water-proof shingle that when painted forms an elegant and durable external covering for structures, superior both in durability and appearance to any ordinary form of shingle.

This pure asphaltum is also used as a basis for paints and for coating paper, its purity as bitumen and its freedom from coke and other injurious substances rendering it greatly superior to coke, pitch and many cheaper and undesirable forms of natural bitumen.

Printer's ink of very superior quality is also made one of the products of this remarkable technology.

Besides the refinery at Santa Paula there is another establishment at Alameda Point, in San Francisco harbor, where oils from this region are given similar treatment.

This industry is in its infancy. The purposes to which these remarkable products can be applied are only partially known and very imperfectly appreciated. It is not only my intention to call attention to the fulfilment of predictions made in 1866, that the oil interests of Southern California would ultimately yield a profitable return upon capital invested; but to also call attention to the great scientific interest attaching not only to the geology but technology of the unique and hitherto unfamiliar products of this remote region.



a, stream at foot of hill; *bb*, mass of maltha, asphaltum and rubbish; *c*, derrick of 1880; *d*, well of 1880; *eee*, barren sand stone strata; *f*, derrick of 1865; *g*, spring of water and maltha from oil-bearing strata pierced by well *d*, of 1880; *h*, well of 1865 in barren sand stone strata.

[1] Reports of the Tenth Census of the United States, Vol. X., Petroleum, p. 68, plate XI.
Geological Survey of California, Geology, Vol. II., appendix p.

—It is understood that the "History of the United States Navy," upon which Mr. Edgar Stanton Maclay has been engaged for the last nine years, is now nearing completion. It is a curious fact that no complete history of the navy has been published since Fenimore Cooper's time, and Mr. Maclay's elaborate work will meet a demand which has grown stronger since the public became interested in the building up of our new navy. Mr. Maclay's history comes down in 1894. D. Appleton and Co. are the publishers.

INTERPRETATION OF MAYA GLYPHS BY THEIR PHONETIC ELEMENTS.—PART II.

BY HILBORNE T. CRESSON, A.M., M.D.

PROCEEDING with the analyses begun in Part I of this article, there is on Plate II, fig. 14, a glyph which appears in the Codex Cortesianus, Plate 16, among a series of five glyphs just above an ideo-phonetic drawing of *Hun Kimil*. In fig. 171, Plate I (see *Science*, No. 567, vol. xxii.), attention has already been called to one of this series of glyphs and the suggestion made that the phonetic elements composing it recall the name of *Kukulkan*. It is but a variant of fig. 160, Plate I; see analysis of the glyph given in Part I of this article. The glyph to the left of this, the analysis of which is given on Plate II, figs. 226, 227, 228 to 234, reads *ah chun Kan*, and by reference to the Codex Cortesianus, Plate 16, it will be seen that there is still another which is a variant of it, repeating *ah-chun-can*. Next to it, reading from right to left, is the glyph referred to above, fig. 14, which we analyze on Plate II, figs. 15, 16, 17, 18, 19, 20, as *Xakan-ik*="the revolving wind." Reference will be made to this presently. The last of the series (See Plate 16, Cortesianus) is the glyph Plate II, figs. 240 to 245, the elements of which, as in the glyphs shown at figs. 1 to 5, 6, 7, 8, 9 of the plate (see day signs of Landa; Troano 6), express "Hun-ki"; the *m* and *il* do not seem to be expressed in any of the glyphs of *Hun-Kimil*. Other examples of abbreviation are to be remarked, as in the day sign *Muluc*, generally expressed "u-uk," and in the day sign *Lamat*, generally expressed "Lamak," at times "am-ak" (see glyphs day sign *Lamak* in *Chilan Balam* of *Kaua*); at times "ach" or "ak" (see Troano 6, 11, 18, 30, 31, 32, 34). In looking over a series of analyses of the day signs, all of which interpreted by my list of phonetic elements have yielded the names suggested by Landa, the names of the day signs *Muluc* and *Lamat* are less clearly expressed by the elements composing them than those of the other day signs. The glyph fig. 10, Plate II, taken from the *Chilan Balam* of *Kaua*, gives a series of these elements which are similar to those we have derived from the codices; using the elements fig. 11 as *hun*, and fig. 12 as *un*, we obtain "hun" or "hu-un"=*hun*. The syllable *Ki* is derived from the value assigned this element on my phonetic list (see Part I of this article, *Science*, No. 567, page 326), Plate I, figs. 1 and 2=*ka* v/s; thus: *Ka, Ke, Ki*.

Vowel fluctuation, I repeat, must not be overlooked in this method of interpretation now described by me; in fact it is my opinion that the Maya glyphs can never be interpreted without considering it as an important factor in the work. The method of the Touaregs of the Sahara in deciphering their manuscripts affords a clue, for it is said that when the natives undertake this difficult task they begin by spelling the consonants aloud . . . applying to them in succession the various vowels until a word is found that makes sense. In fact, it is absolutely necessary to proceed in a like manner in the Maya script, only, instead of chanting, the combinations can be worked out with pencil and paper. In an endeavor to interpret a series of glyphs the amount of labor that this requires can be duly appreciated. The rest of this article will simply be devoted to an explanation of these fluctuations, adding, where necessary, a few remarks upon the interpretations made.

Fig. 21 is a well known compound glyph, variants of which frequently appear in the hieratic script and the codices, especially in the Peresianus (Plates 2 to 10). The phonetic elements of one of its components, Fig. 22, it will be seen by reference to figs. 23, 24, 25, Plate II=*bacab*. It is a variant of the day sign *Been* and was evidently used by the scribe to express *be*, derived from its phonetic value of *ba* v/s. The next component is fig. 26, where we have the curved aspirate line, fig. 27=*xa* v/s, *cha* v/s, the serpent curve, fig. 28=*Kan*, *chan*, *Ka* v/s, and the parallel line=*ik*, derived from one of its values of ka v/s. We have here a repetition in a new combination of the word *xakan-ik* = "The Revolving Wind," which has already been suggested by the glyph fig. 14, Plate II. The element fig. 30 is in fact closely allied to the *x*, *ch*, and *sh* sounds, the curved element, fig. 28, supplying the monosyllable *Kan;* this associated with the curved aspirate line, fig. 127, gives *xan* or *xakan* or *shakan*. The rest of the phonetic elements composing this glyph, fig. 31, repeats *ik*, fig. 32=*cha*, fig. 33=*kan*, fig. 35=*ik*. The enclosing outline of this glyph is not unlike the single curved *Kan* line, fig. 34, and it seems like a variant of fig. 228, also a *Kan* element and a component of the compound glyph, fig. 226, with the element fig. 227 placed above, this element, fig. 227, also appearing in fig. 21, fig. 32, just above fig. 33. The enclosing outlines of certain glyphs have at times an ideographic significance which it would be well for Maya paleographers to bear in mind. In this case fig. 33 has for its principal phonetic element a motive obtained from the serpent line, fig. 192, Plate I, *Science* No. 567; see also fig. 122, Plate I. The outline enclosing it is adapted to the curve of this element and is evidently a determinative sign, being purely ideographic. The glyph fig. 27, therefore, repeats *Bacab xakan ik*="*Bacab* of the revolving wind," or, still better, "Of the shifting or changing wind." The sense intended is evidently *Bacab*="ruler," *xakan ik*="changing wind," or "wind that blows from the cardinal points." As this glyph is intimately associated with the *bacab* and *chak* cult in the Peresianus, the interpretation, it cannot be denied, is a probable one. If space permitted much interesting material, the results of analyses of glyphs in other codices, could be brought to support the truth of the interpretation given.

Fig. 36 is a glyph which appears in the Codex Peresianus, Plate 17. Its phonetic elements and their values are given in figs. 37, 38, 39, 40=*xakan ik*, a third repetition of this sentence. The glyph fig. 36, Plate II, is attached to the support of a representation of a straw house (*xanil-na*); see Plate 17, Peresianus. Underneath the house is the representation of *Kukulkan* in the act of turning over or revolving, symbolizing the sentence *xakan-ik* (or it may be *chak, kan, ik* = Chak, or "God of Serpents and Wind"). There are some interesting facts in connection with this figure, which is ideo-phonetic. Its ideographic sense, the action of revolving, has just been suggested. The color of the garment covering the body of the chak is green=*xan*, on which are small squares of a darker green color arranged by twos (=*Ca*) and by fours (=*Kan*), suggesting xakan; the black squares attached to the roof arranged in pairs=*Ka* v/s (=2) or ik, together with the red color back of the figure (=*chac*) and the yellow colors of the straw roof (*Kan*=yellow). All of these accessories are ikonomatic and recall Chak-kan-ik or xakan-ik, supporting the interpretation that we have made of the glyph fig. 36, Plate II, which is attached to the support of the roof of the straw house. I am loth to consider all of these facts the result of mere accident; there is too much method in their arrangement. The colors used are without doubt ikonomatic. On Plates 15, 16, 17, 18, *Peresianus*, there are many repetitions of the words, chak-ikal = "the hurricane" and "xakan-ik" = "the revolving" or "whirlwind." We find the sentences repeated in the Dresden Codex and in certain parts of the script of *Palenque*—notably on the bas-reliefs representing Kukul-kan as Chak of Water and Wind, that atone time stood at the right and left of the doorway of the temple of the Four Winds and Chaks at Palenque (so called Temple of the Cross); "the cross" being simply, as Brinton first suggested, a wind symbol.

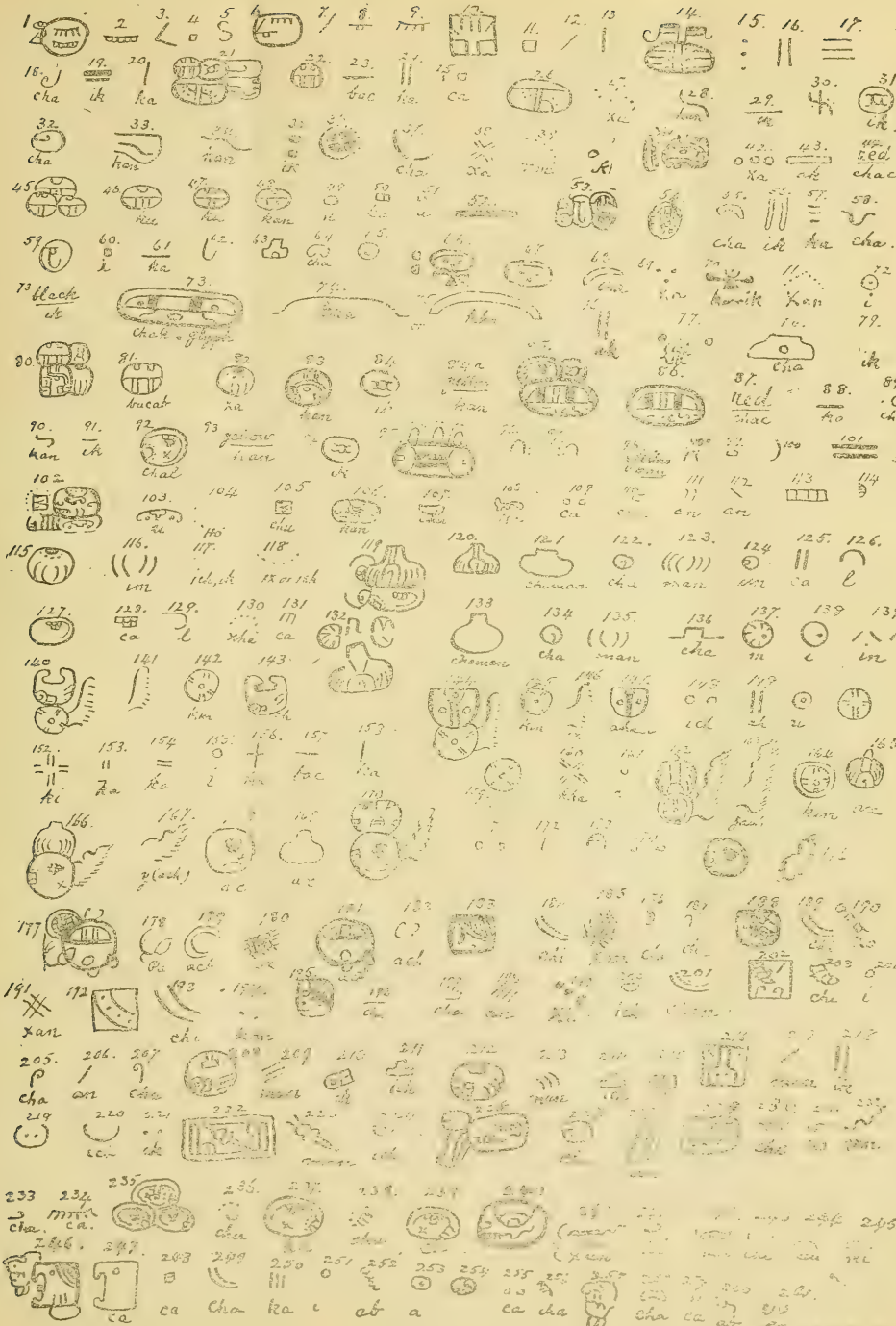


Plate II.

Before proceeding further it must be remarked that in fig. 40, Plate II, we have given the color black, which plays such a conspicuous part in the glyph, fig. 36, the phonetic value of *ek* or *ik*. It frequently appears with these phonetic values in Maya script, and it is my opinion that red may also have the phonetic value of *Chac*, cha v/s, yellow *Kan*, ka v/s, and green *xan*, *xa* v/s. It will be impossible to discuss the subject here; we leave the suggestion to time to decide, but attention is called to the fact that color seems to be ikonomatic in Maya script. Above the *ideo-phonetic* figure in Plate 17, Peresianus, (a compound of ideographic suggestion and phonetic elements), is a series of glyphs whose analyses are made on Plate II, figs. 41 to73. It will be observed that many of the phonetic values assigned by me to certain phonetic elements are being repeated in new combinations with probable results. The interpretation given is *u-chak Kukulkan*, *chakikal*, *Chakanik*. There are two more glyphs in this series on Plate 17 (Peresianus), but as they are somewhat erased it would be necessary to compare them with others on Plates 15, 16. 18, (Peresianus), and other parts of this codex, which is here impossible. The series of glyphs on all of the plates referred to, viz.: 15, 16, 17, 18 (Peresianus), read from the lower right hand glyph toward the left, thus:

F. E.
D. C
B A

and repeat name of *Kukulkan* with reference to his title of God of Wind and ruler of the cardinal points. The order of repetition of the words given by the glyphs varies in some of the plates. The series is in fact a repetition of the compound glyph of the Peresianus, as shown in my plate, fig. 21, with the addition of the title *Chakikal*, thus: *Bacab*, *xakan ik*, *Chakikal* = "Ruler of the Cardinal Points, God of Wind." (*Bacab* = ruler, xakan-ik=the "cardinal points" or the winds that revolve around it; *Chak*="God," *ik*="wind," or this latter may be read="hurricane.")

Especial attention is called to the glyph fig. 45 in this series, where three *Kan* glyphs express the name *Kukulkan*, their different phonetic values being indicated by the small *phonetic additions* attached to the top of the glyphs inside of its enclosing circle, see figs. 45, 46, 47, 48, 49, 50, 51. The name of *Kukulkan* is also repeated on Plate 23, Peresianus; three *Cauac* glyphs being used, their values being changed by the phonetic additions attached. See figs. 235, 236, 238, 239, Plate II.

Fig. 73 is a well-known glyph in the Peresianus. It has been designated by me the Chak glyph from the fact that the phonetic elements within it express that word and the figures attached to the glyphs in the Peresianus, there is good reason to think, are *chaks* or *bacabs*, supporting my analysis of its phonetic elements. The phonetic elements of which it is composed are frequently repeated in Maya script and are among the most primitive of those represented in Part I of this article, published in *Science*, No. 567.

A repetition of the title Bacab-xakanik, with the yellow color appearing with phonetic value, is given in the series, Plate II, figs. 80 to 84*a*, taken from Plate 16, Peresianus. See also series figs.85 to 101. The glyph fig. 102 my analysis indicates to be that of *u Hoobnil-Kan*. The dotted aspirate circle, fig. 104, gives *Ho*, derived from the phonetic value of *cho* or *sho*, *xo* v/s. The square, fig. 105, encloses the same elements that are found in the day sign *Chuen*, and its phonetic value *cha* is indicated by the square in which it is enclosed—the square, generally, being associated with á, *Ka* v/s, sounds. If the same elements referred to were in a circle they would probably be *cho* or *chu*, as the circle is intimately associated with i, o, u, *ch*, *ik* sounds. The square and circle are probably vowel elements; see Article I, Plate I, figs 27, 43.

NOTES ON THE GENUS STROMATOCERIUM.

BY HENRY M. SEELY, MIDDLEBURY, VERMONT.

One wishing to recall the typical form of the genus *Stromatocerium* turns to Hall's monumental work, "Palæontology of New York," and in Vol. I., p. 48, finds the description of this well-marked genus. The horizon of *Stromatocerium vagosum* is that of the rocks of the lowest member of the Trenton period, that is, the Black River. This fossil is accepted as a guide in determining the rocks of that epoch.

That this form should flit across one geological horizon, should come and go, having no ancestry and leaving no descendants, seems strange. But this sudden appearance and disappearance is more apparent than real. It may not be possible to trace exact lineage, but likenesses and relationships are quite evident. The relatal forms are *Cryptozoon* below and *Stromatopora* above. It is true these are somewhat widely separated, both by structure and by stratigraphical position. Yet in general structure they are so alike that one has often been mistaken for the other.

We may briefly consider the stratigraphical relation of the *Stromatocerium* to the *Cryptozoon* in the rocks lying below. Immediately beneath the Black River is the Chazy, the rocks of which at their best estate have a thickness of near 900 feet. Beneath the Chazy lies the Calciferous, with its distinct divisions of rocks, the formation having a thickness of near 2,000 feet.

The rocks of these two epochs bordering Lake Champlain and filling so great part of the valley between the Green Mountains and the lake have a recognized likeness. Had not the name, Champlain, been preoccupied, this term could have been applied with appropriateness to the time period which would be constituted of the two epochs, Coazy and Calciferous.

The Chazy rocks may be looked upon as a wedge separating the Calciferous from the Black River rocks. The edge of this wedge in some places thins down and disappears, so the Black River is let down in contact with the Calciferous. The stratigraphical separation between the *Cryptozoon* and the *Stromatocerium* thus becomes zero.

So far as horizon is concerned the Cryptozoon may have clambered up into the Black River rocks. But the piling up of a little less than a thousand feet of Chazy rock, mostly calcareous, indicates the passage of a long interval of time. The sponge-like forms of the Chazy are not *Cryptozoa*. The concentric structure has been retained by several, yet they are clearly distinguishable from that fossil. One of the most noticeable of these forms is a *Stromatocerium*.

The genus as characterized by Professor Hall may admit of considerable variation, yet these Chazy forms in all essentials correspond to the type. They differ, however, from *Stromatocerium vagosum*, and so widely do they diverge that the difference can hardly be less than specific. They have been studied with some care and specific names applied, but a general statement of position and character will be enough for the present.

The divisions of the Chazy rocks may be properly designated from below upward A, B, C. Distinct forms of *Stromatocerium* are found in each. That found in A, the lowest division, has a growth in shape and sometimes in size like the old-time straw bee hive. It appears in B but somewhat modified in form. The special form in B is peculiar in growth and massiveness. The fossil is made up of a series of corrugations, these being from a quarter of an inch to a half inch in height. Blocks three feet by

eight lifted from the quarry are sometimes made up mostly of this form. In division C are several forms; a noticeable one has its fresh surface covered with mastoidal eminences; these when cut down by weathering leave a series of beautiful rings or concentric circles. Examples of this species are not unlike an inverted saucer in shape.

The species found in A may be collected at Chazy, N. Y., and at many localities in Vermont; those in B and C at their appropriate horizons at Isle La Motte, Vt. The form in B is incidentally largely distributed through the country and will be found when looked for in the tiled floors of almost every public building where Isle La Motte marble has been used. In museums, too, it will be found under title of "Isle La Motte banded limestone." The place above all others for display of *S. vagosum* is a little island, at the entrance of Button Bay, three miles south of Fort Cassin, Vt., where a layer 20 to 30 inches thick is exclusively of this form and *Columnaria alveolata*, *H.*

The following facts are evident: (1) the genus *Stromatocerium* does not make its first appearance in the Black River; it is there rather in its decadence; (2) it appears in the lower Chazy, following close upon the *Cryptozoon*, and persists through the different divisions; (3) it cannot of itself be trusted as a safe indication of the Black River.

However, it should be noticed that *Stromatocerium vagosum* is most frequently paired with *Columnaria alveolata*, and the presence of the two forms establishes beyond question the presence of the Black River.

DR. CALLAWAY AND THE PRODUCTION OF CRYSTALLINE SCHISTS BY DYNAMO-METAMORPHISM.

BY J. W. REDWAY, F.R.G.S., MT. VERNON, N.Y.

About fifteen years ago, while setting a piece of heavy mining machinery that revolved on a vertical shaft, work was brought to a stand by the discovery that the journal, intended as a chair and box for the cone-shaped bearing, was considerably too small. A speculative workman thought it might wear down to shape, however, and started the machinery. The experiment, though of doubtful success from a mechanical standpoint, was brilliantly successful in another light. The bearing and journal, both of drop-forged steel, were welded to each other and broke into a dozen pieces. The interesting point, however, was the fact that two forgings of laminated steel under the agency of heat were converted to a metamorphic form. At the surface of welding the laminated steel became crystalline, and even the parts at some distance became semi-crystalline. It was a fair illustration of what is now called dynamo-metamorphism.

In a very remarkable paper presented to the *Quarterly Journal* of the Geological Society of England, Mr. Charles Callaway, D. Sc., F.G.S., has published the result of his researches on the origin and formation of certain crystaline schists found in the Malvern Hills, in the west of England. A close study of these schists during a period of five years has brought Dr. Callaway to the conclusion that they were produced by a dynamo-metamorphosis not different in essential principles from the illustration described in the preceding paragraph. Ordinarily, metamorphism in rocks may be briefly described as the change that a sedimentary rock undergoes when subjected to intense pressure in the presence of heat and moisture. The rock becomes more or less crystalline, and there is a tendency from homogeneity to heterogeneity in mineral structure. The production of metamorphism by the shearing of rock and the gradual sliding or movement of the one mass upon the surface of the other is called dynamo-metamorphism. Neither the name nor the idea originated with Dr. Callaway, but the thorough exposition the subject has received at his hands entitles him to a foremost place among the pioneers in this field of research, and the results he has obtained are an important step in advance in the field of dynamic geology.

The Malvern Hills are mainly composed of masses of igneous rock, granitic in character, the constituents chiefly considered being binary granite and two kinds of dorite. In certain localities there are exposed bands of crystalline schist, apparently as seams of subsequent intercalation but really cataclastic in origin. These seams are the shear-zones within which the schist-making process occurred. Aside from the normal metamorphism which took place, the chief factor seemed to be a distinct shearing movement that resulted in a fusion sufficiently complete to produce plasticity.

Among the mechanical changes was the transformation of diorite into mica-gneiss. In the process of transformation the pulverized mineral not infrequently passed through an intermediate stage of laminated grit that simulated a sediment. A still more interesting change was the injection of potash and potassium feldspar into diorite, and a similar transference of the corresponding sodium salts into granite. In still other cases, diorite and granite were mutually interlaced. Chlorite and ferric oxide produced by the decomposition of diorite were injected or infiltrated into the cracks, cleavage and shear-planes of crushed granite and often migrated to a considerable distance, giving rise to an interfoliation of chlorite and biotite with the quartz, feldspar, and muscovite of the resulting gneiss.

The mineral changes may be classified as (*a*) decomposition, (*b*) transition, and (*c*) reconstruction. The massive rocks pass into schists through a process of decomposition, followed and partly accompanied by a process of reconstruction, in which the newly-formed quartz and feldspar crystallize, after the secondary consolidation. The chief mineral changes of the schist-making process are (*a*) the replacement of orthoclase by quartz and muscovite; (*b*) of plagioclase by the quartz and muscovite; (*c*) of chlorite by biotite and white mica; (*d*) and of biotite by white mica. The liberation of potassium from the granite is sometimes accompanied by silicification of the veins and the production of garnets. The reconstruction of feldspar is also a prominent feature in the metamorphism.

Among the chemical changes the following are noteworthy: (*a*) the mutual transference of sodium and potassium compounds between diorite and granite, also previously noted among physical changes; (*b*) the removal of sodium, potassium, magnesium, calcium, aluminium and iron compounds when diorite is converted to gneissoid quartzite; (*c*) the retention of aluminium and the elimination of alkaline compounds when diorite is metamorphosed to muscovite.

Dr. Callaway's researches involved the preparation of about 500 thin sections of rock for study with the microscope, and a large number of chemical analyses. His hypotheses are bold and ingenious, involving metasomatosis on a large scale. Subsequent investigations, however, have not disproved them; on the contrary they have been strongly confirmed. It is interesting, moreover, to compare the work of Dr. Callaway with that of Mr. Van Hise on the schists of the Penokee iron-bearing series (U. S. Geol. Survey, Rep. 1888 and 1889, pp. 429 et seq.). The ideas shadowed in Mr. Van Hise's report could not have been more fully confirmed than they have been by Dr. Callaway, working independently at the same time on rocks several thousand miles away.

MEMORABILIA BOTANICA, I.

(Edited by Erwin F. Smith, B.S., D.S., Washington, D.C.)

CABINET WOODS AT THE FAIR.

One of the most interesting forestry exhibits at the Columbian Exposition was from New South Wales. The variety of their hard woods and the polish many of them take was a surprise to Americans. The only exhibit approaching it in beauty was that from Michigan. The woods of New South Wales must certainly come into extensive use at no very distant day. For novelties in cabinet ware nothing could be more attractive, and it would seem that such treasures need only to be exploited to find their way everywhere among lovers of the beautiful. In looking over this collection from the antipodes one could not repress a burst of thankfulness at finding it properly labeled. The exhibits from a number of countries, Spanish ones in particular, were robbed of much of their interest by indifferent labeling. To look over a large number of woods, all polished at great expense and some of them exceedingly beautiful, only to find Spanish or Indian names, was, from a scientific standpoint, rather discouraging, to say the least. In many cases one could not learn even the natural family, much less the genus and species. The matter is the more to be regretted since such opportunities for study come but rarely.

THE UNCERTAINTIES OF COMMON NAMES.

The necessity for the more general use of scientific names in books of travel, economic works and various writings of a semi-scientific character, could not be impressed more forcibly than by this same forestry exhibit of New South Wales. For an American, especially if he desires to reach the common people, it is the most natural thing in the world to think everybody will know what he means by such names as white pine or red cedar. These names are not likely to be misunderstood in the United States, but if an author's writings are to be permanently useful to science the whole world over, then he must use the common language of science. To illustrate, New South Wales has an exceedingly varied flora, but not many of its genera, and very few, indeed, of its species, grow in the United States, and yet many of their common names are identical with our own. Plants of the United States and New South Wales, of very diverse genera, bear the same common name, *e.g.*, according as one is American or Australian, elm means *Ulmus* or *Aphanathe;* tulip tree, *Liriodendron* or *Anopterus;* apple tree, *Pyrus malus* or *Angophora intermedia*; honeysuckle, *Lonicera* or *Banksia*; sycamore, *Platanus occidentalis* or *Cryptocorya obovata;* hazle, *Corylus* or *Pomaderris;* dogwood, *Cornus* or *Myoporum;* ironwood, *Ostrya* or *Tarrietia;* white cedar, *Cupressus* or *Melia;* mountain ash, *Pyrus americana* or *Eucalyptus virgata;* white pine, *Pinus strobus* or *Frenela robusta;* sassafras, *Sassafras* or *Doryphora;* red cedar, *Juniperus virginiana* or *Cedrela australis;* beech, *Fagus* or *Gemelina;* hickory, *Carya* or *Acacia;* swamp oak, *Quercus* or *Casurina;* box, *Buxus* or *Eucalyptus;* black oak, *Quercus* or *Casurina;* red ash, *Fraxinus pubescens* or *Alphitonia excelsa;* black ash, *F. sambucifolia* or *Cupania semiglauca*. Now suppose an economic writer of New South Wales to deal only in common names, and then imagine the confusion of an American reader, or reverse the case and imagine the perplexity of the Australian, if the diverse usage of the two countries were not known. The absurdity is apparent, and also the need of greater exactness in specifying what is meant by a common name. When the common name is in a foreign language the difficulty of arriving at the author's meaning is still greater, as everybody knows who has been compelled to depend on the imperfect and not seldom contradictory statements of lexicographers.

THE COFFEE DISEASE OF CEYLON.

Persons interested in coffee may have noticed in the Ceylon building at the Fair a big chart showing an astonishing decrease in the coffee product of that island during recent years. Formerly Ceylon was one of the great coffee producing regions of the globe, but within a decade the exports have fallen off so much that now the island scarcely cuts any figure in the total product of the world. Probably very few readers of *Science* know the cause of this. It has not been due to adverse legislation or to over-production in other localities, but almost solely to the ravages of a rust fungus, *Hemileia vastatrix*, which has destroyed the foliage on the coffee plantations in whole districts year after year. The losses have been so sweeping and disastrous as to bankrupt individuals, discourage planting and practically ruin a great industry. Dr. Haberlandt states that many of the large and beautiful coffee plantations can be bought to-day for one-tenth of their former value, the decrease of property values on account of this disease being estimated at about 10,000,000 pounds sterling. Recently it has been reported that the disease can be prevented by the use of copper fungicides. Owing, however, to the close planting of the groves, young trees under old and all interlacing, it is said to be impossible to spray with machinery and that the use of knapsack sprayers is too slow and expensive to be practical. The disease also occurs in Java, but lovers of the berry will be glad to know that it has not been reported from Mexico or Brazil.

BOTANY IN SECONDARY SCHOOLS.

For a long time the botanists of the country have recognized the sad state of botanical teaching in most of our high schools and smaller colleges. Chemistry and physics are taught experimentally, *i.e.*, by laboratory methods, in all except a few hopelessly antiquated and fossilized schools, but botany is still taught quite generally by the old text-book-parrot method. Teachers do not seem to know that there is any better way, or that reciting lessons from a book is one thing, and the study of nature quite another. Indeed, the public mind itself, quite generally, needs to be disabused of the idea that science can be learned out of books. Books, when well written, are useful stimuli and valuable repositories of facts, but a man may study the printed page until he is gray without getting in touch with nature or acquiring the scientific spirit. Living, fruitful knowledge can come only from grappling directly with the phenomena of nature. This is why it is possible for students to take a three months' or six months' course in botany, so-called, and still have no interest in plant life, bringing away from their study nothing better than a meagre portfolio of incorrectly determined snips (there were some of these on exhibition at the Fair), a hopeless muddle of technical terms, and the lifelong feeling that botany is a very dry and uninteresting subject. On the whole, no instruction at all is perferable to such teaching. Those who have realized the badness of this sort of teaching have done what they could individually to improve it, but without any great measure of success. Now it is proposed to see if an organized effort will not be more fruitful. The subject came up for discussion in Section G (Botany) at the Madison meeting of the American Association for the Advancement of Science, and a committee was appointed to devise ways of improving botanical teaching in secondary schools. This committee will report to the Section next year, and if their report is approved it is hoped that it can go before the country with the endorsement and influence of the whole Association. Teachers who are groping about for

better methods, those who have already found good ways, and all who are interested in botanical progress in the United States will do well to correspond with the members of this committee,—Douglass H. Campbell, Palo Alto, California; N. L. Britton, New York, and Jno. M. Coulter, Lake Forest, Ill.

EMBRYOPHYTA ZOIDIOGAMA.

A RECENT double number of *Die Natürlichen Pflanzenfamilien* begins consideration of the higher cryptogams, the Embryophyta zoidiogama or Archegoniatae. This grand division of the vegetable kingdom is defined as follows:

"Plants seldom thalloidal, mostly differentiated into stem and leaves (cormophytic), and having two distinct generations. The proembryonal or sexual generation bearing antheridia in which spermotozoa are developed and Archegonia enclosing the egg cell, which is to be fecundated, and the canal cells, which change into slime prior to the act of fecundation. After fecundation the non-sexual embryonal generation or embryo arises by division of the egg cell and further growth, remaining a long time in connection with the proembryonal generation and being nourished by it."

The following subordinate groups are recognized, and the progress of systematic botany during the last forty years cannot be better understood at a glance than by comparing this system of classification with that given in Lindley's "Vegetable Kingdom."

(1) SUBDIVISION. BRYOPHYTA (MUSCINEI).

1. Class Hepaticae (Liver mosses).
   1. Sub Class Marchantiales.
   2. Sub Class Jungermaniales.
2. Class Musci (Musci frondosa, or Leafy mosses).
   1. Sub Class Sphagnales.
   2. Sub Class Andreaeales.
   3. Sub Class Archidiales.
   4. Sub Class Bryales.

(2) SUBDIVISION PTERIDOPHYTA.

1. Class Filicales.
   1. Sub Class Filices. Genuine ferns (Isosporae).
   2. Sub Class Hydropterides (Two sorts of spores).
2. Class Equisetales.
   1. Sub Class Isosporeae.
   2. Sub Class Heterosporeae.
3. Class Sphenophyllales.
4. Class Lycopodiales.
   1. Sub Class Isosporeae.
   2. Sub Class Heterosporeae.

This double number (91 and 92) brings Division 3 of Part I down to page 93, and deals with the following groups of liverworts: *Ricciaceae*, *Marchantiaceae*, *Jungermaniaceae anakrogynae*, and *J. akrogynae*. All by v. Schiffner, with many illustrations.

SOUTH KENSINGTON.

THE Kew Gardens are well known in the United States as the centre of an enormous amount of a conservative kind of botanical energy, mostly floristic, but it is not so generally known that Kew has a formidible rival at South Kensington. Indeed, in many ways, according to all accounts, and notably in the facilities offered to visiting botanists, and in the extent of its library, it is far ahead of Kew. The botanical library at South Kensington is now one of the best in the world, nearly $100,000 having been spent on it within the last decade, and the collections are also valuable. The director, Mr. Carruthers, wishes it understood that South Kensington is in full sympathy with the new botany and that specialists from every quarter of the globe are welcome and will be given every possible facility, in the way of books and collections, for the pursuit of original investigation, whether of phænogams or cryptogams.

CURRENT NOTES ON ANTHROPOLOGY.—NO. XXXIX.

(Edited by D. G. Brinton, M. D., LL. D., D. Sc.)

INSCRIPTIONS ON FRENCH MEGALITHIC MONUMENTS.

THE megalithic monuments of France are divided into great upright stones, *menhir*, groups of these, *gromlech*, and large flat stones superposed on others which are upright, *dolmen*. There are about thirty-five hundred of the latter in France, and still more of the former varieties. They used to be attributed to the Celtic Druids, but later writers hesitate to accept this identification. Some of them have figures inscribed upon them, not generally of men or animals, but apparently of a symbolic or even alphabetic character.

During the year 1893 two suggestive articles on these "alphabetiform" and other inscriptions appeared in the Bulletins de la Société d'Anthropologie of Paris, the first by Ch. Letourneau, the other by A. de Mortillet. In comparing the characters on the dolmen "des Marchands," in Brittany, with similar remains elsewhere, M. Letourneau made the interesting discovery that many of them were identical or very similar to those found in what are called the "rupestrian inscriptions" of Tunisia and southern Algeria. These are of Libyan origin, and by most recent scholars are held to preserve a form of writing older than the Punic alphabet, and akin to that which is seen on ancient Numidian mortuary tablets. This discovery is the more important, because the megalithic monuments can be traced from Brittany into northern Africa in an almost continuous line, indicating that those who constructed them followed this path, either in one direction or the other.

The figures reported upon by M. de Mortillet are from a series of these monuments in the vicinity of Paris. They do not present the "alphabetiform" appearance, but are crude representations of human beings, "in which the principal aim of the artist was to indicate the sex."

RELATION OF THE GLACIAL AGE TO MAN.

THE great event of the glacial period, or Ice Age, bears an important relation to the calculations of the appearance of man on earth. The most recent studies in post-pliocene geology are, however, far from unanimous on glacial questions, and this has reacted forcibly on writers about the origin of man. One who is generally very careful, the Marquis de Nadaillac, has actually been led in a recent article, of great merit, entitled "Les Dates Préhistoriques," to the extreme conclusion that "the remotest epoch to which we can assign the appearance of humanity on the globe can scarcely exceed 10,000 years."

He bases this conclusion largely on the writings of American geologists, as Warren Upham, Gilbert and Winchell, who from their observations of the gorge of Niagara, and other so-called "geologic chronometers," have reduced the period since the final departure of the great ice mass to six or seven thousand years.

Both these conclusions have very much the air of a *reductio ad absurdum*. They are in conflict with so many known facts and high probabilities in other directions that they disprove themselves, and indicate some radical error of theory. A much more plausible theory, which accounts for the "chronometers," and does not violate probability, is that which is advanced by Mr. F. B. Taylor, of a prolonged subsidence posterior to the ice age, the proof of which is in a continuous coast line from the Atlantic to Duluth. He is preparing to present the full evidence for this.

THE ANCIENT INHABITANTS OF SALT RIVER VALLEY, ARIZONA.

A PUBLICATION highly interesting to the ethnic anatomist is a memoir recently published in Washington, entitled, "Human Bones of the Hemenway Collection in the United States Army Medical Museum," by Dr. Washington Matthews and Dr. J. L. Worman.

The valley of the Rio Salado, or Salt River, was explored by this expedition under the direction of Mr. Frank H. Cushing. It proved to be the seat of a pre-Columbian civilization of rather high type, which, according to the opinions of most, must have disappeared at least a thousand years ago. The human bones obtained from the old graves present a curious series of aberrations. Considered as a single series, they are far from presenting a uniform type. If that fact goes for anything, they must have been a tribe of very mixed blood. Generally they were brachycephalic (probably from cradling), and not tall. Their teeth decayed early in life, and were often misplaced and irregular. The Inca and Wormian bones were abundant, almost beyond example. As for flattened tibias and perforated olecranons, they break the record for frequency. No other series yet measured equals them in these defects. The hyoid bones offer singular deficiencies in ossification. The cubical capacity of the skull is very low, about 1313.

The impression the anatomist receives from reading the memoir is, that he sees presented a people in a low and sinking stage of physical vigor, drifting toward rapid decadence and extinction. Just such a condition prevailed in Peru at the period of the conquest of Pizarro; and from this analogy in condition, social and physical, not from geographic or ethnic relations, should be explained, I think, the various resemblances in structure and social development which the authors of this memoir note and dwell upon (rather too forcibly) between these widely-sundered nations.

THE VEDDAS OF CEYLON.

THE Veddas are a strange and ancient people, who live in the hottest and most pestilential swamps and forests of Ceylon, leading a thoroughly savage life, nearly naked, in temporary shelters, cultivating nothing, and avoiding as much as they can any intercourse with the other natives of the territory. Out of a total population on the island of two and three-quarters millions, they number only about 2500; but in ethnic interest they are the most noteworthy of all; for in them, it is believed, we have preserved the sole representatives of the original inhabitants of the island.

Excellent studies of them have been recently published by Drs. P. and F. Sarasin, in their large volume on the scientific exploration of Ceylon, and by Dr. Emil Schmidt, in the first number of *Globus*, for the present year. From these sources we learn that the Vedda belongs to the smaller races, the average height being about 1.45 meters; his color is medium brown, his hair slightly curly, his eyes black, his head narrow and small, with an average capacity of about 1200 c. c. His face is not prognathic, and, from the photogravures of Schmidt, he often has pleasing features and an agreeable expression. Except on the head, the hair is scanty, and in the details of his anatomy he betrays a general lack of development, which by some anatomists would be called a "pithecoid" or ape-like tendency.

The Veddas have few institutions and faint religious observances; but the latter are not absent, as Herbert Spencer has asserted. The language is Singhalese, at least in great part; but it is probable that a certain stratum of it is connected with some of the Dravidian dialects of Southern India. The Veddas, indeed, apparently should be classed with that primitive stock which at some remote time divided into the various members of the Australo-Dravidian family.

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*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as a proof of good faith.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The Editor will be glad to publish any queries consonant with the character of the journal.

Cats Hunting Snakes.

It was a novel idea to the writer, that of our domestic cat appearing in the capacity of a serpent-killer; but as two independent accounts have recently come to his knowledge, from competent observers, this note is sent to *Science*, partly for its interest and partly in the hope of eliciting further evidence.

A family living in southern New Jersey have a cat, not large or powerful, but very lithe and active, that has been in the habit of going off to the woods and returning with dead snakes of different species, up to three or four feet in length. After dragging it home, she would proceed to *eat* the snake and was often interrupted and the prey taken from her by members of the family, who were horrified at the proceeding. On one occasion, a violent flurry among the hens was noticed, and it was found to be due to the approach of a black snake, fully a yard long. The cat had reached the spot, however, before the family, and her *modus operandi* was witnessed. She attacked the snake by repeatedly springing upon it, and endeavoring to seize it with her teeth, immediately behind the head. After a few such assaults, the cat killed it, and in due time proceeded to eat it, as usual, although it was then removed.

On relating this incident in a company of scientific friends it was generally regarded as novel; but one gentleman described a precisely similar action witnessed by him in Harlem, N.Y. A disturbance was observed in the rear garden, and the large family cat was found making just such attacks upon a garter-snake between two and three feet long. The snake was partly protected under a dense clump of rose bushes, and the cat had difficulty in seizing it, but kept springing at the neck, as in the other case. The gentleman at once interfered, and dispatched the reptile with a stick. But it would seem from these instances that snake hunting is a habit with some cats. Is it so with many? Perhaps some readers of *Science* can help us to judge how far it is familiar.

D. S. Martin.

The American Box Tortoise.

Permit me to call the attention of those interested in zoölogy to the North American box tortoise or *Terrapene* (*Cistudo*). In working over the material so far collected we notice no mention of material from Georgia, Tennessee, Alabama, Kentucky, the Dakotas, New Mexico or western Texas. Neither are specimens reported from Mexico excepting Mexico City. Specimens are vaguely reported to have been found in Canada, but no specimens seem to be preserved and no authentic records are known. It is commonly supposed that the *Terrapene* (*Cistudo*) does not exist west of the Rockies. If any person has evidence to the contrary we would like to know it. We would request all who can give us aid on any of these points to write us. If possible we would like to receive specimens from any locality whatever. The comparatively fixed habitation of this genus renders a large collection including many localities highly desirable. Persons who may have any of these specimens on hand, but do not care to part with them, would confer a great favor by lending them. Favors rendered in this way would be fully appreciated and remembered. All packages or communications should be addressed to undersigned, Walker Museum, University of Chicago, Chicago, Ill.

W. E. Taylor.

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What is the Problem?

In seeking a means of protection from lightning discharges, we have in view two objects,—the one the prevention of damage to buildings, and the other the prevention of injury to life. In order to destroy a building in whole or in part, it is necessary that work should be done; that is, as physicists express it, energy is required. But before the lightning discharge takes place, the energy capable of doing the damage which we seek to prevent exists in the column of air extending from the cloud to the earth in some form that makes it capable of appearing as what we call electricity. We will therefore call it electrical energy. What this electrical energy is, it is not necessary for us to consider in this place; but that it exists there can be no doubt, as it manifests itself in the destruction of buildings. The problem that we have to deal with, therefore, is the conversion of this energy into some other form, and the accomplishment of this in such a way as shall result in the least injury to property and life.

Why Have the Old Rods Failed?

When lightning-rods were first proposed, the science of energetics was entirely undeveloped; that is to say, in the middle of the last century scientific men had not come to recognize the fact that the different forms of energy — heat, electricity, mechanical power, etc. — were convertible one into the other, and that each could produce just so much of each of the other forms, and no more. The doctrine of the conservation and correlation of energy was first clearly worked out in the early part of this century. There were, however, some facts known in regard to electricity a hundred and forty years ago; and among these were that a certain power of points for an electric spark, and the conducting power of metals. Lightning-rods were therefore introduced with the idea that the electricity existing in the lightning-discharge could be conveyed around the building which it was proposed to protect, and that the building would thus be saved.

The question as to dissipation of the energy involved was entirely ignored, naturally; and from that time to this, in spite of the best endeavours of those interested, lightning-rods constructed in accordance with Franklin's principle have not furnished satisfactory protection. The reason for this is apparent when it is considered that the electrical energy existing in the atmosphere before the discharge, or, more exactly, in the column of dielectric from the cloud to the earth, above referred to, reaches its maximum value on the surface of the conductors that chance to be within the column of dielectric; so that the greatest display of energy will be on the surface of the very lightning-rods that were meant to protect, and damage results, as so often proves to be the case.

It will be understood, of course, that this display of energy on the surface of the old lightning-rods is all lost by there being more or less insulated from the earth, but in any event the very existence of such a mass of metal as an old lightning-rod can only tend to produce disastrous dissipation of electrical energy upon its surface,— "to draw the lightning," as it is so commonly put.

Is there a Better Means of Protection?

Having cleared our minds, therefore, of any idea of conducting electricity, and keeping clearly in view the fact that in providing protection against lightning we must furnish some means by which the electrical energy may be harmlessly dissipated, the question arises, "Can an improved form be given to the rod so that it shall do this dissipation?"

As the electrical energy involved manifests itself on the surface of conductors, the improved rod should be metallic; but, instead of making a large rod, suppose that we make it comparatively small in size, so that the total amount of metal running from the top of the house to the point a little below the foundations shall not exceed one pound. Suppose, again, that we introduce numerous insulating joints in this rod. We shall then have a rod that experience shows will be readily destroyed — will be readily dissipated — when a discharge takes place; and it will be evident, that, so far as the electrical energy is consumed in doing this, there will be the less to do other damage.

The only point that remains to be proved as to the utility of such a rod is to show that the dissipation of such a conductor does not tend to injure other bodies in its immediate vicinity. On this point I can only say that I have found no case where such a conductor (for instance, a fell wire) has been dissipated, even if resting against a plastered wall, where there has been any material damage done to surrounding objects.

Of course, it is readily understood that such an explosion cannot take place in a confined space without the rupture of the walls (the wire cannot be boarded over); but in every case that I have found recorded this dissipation takes place just as gunpowder burns when spread on a board. The objects against which the conductor rests may be stained, but they are not shattered.

I wish therefore to make clear this distinction between the action of electrical energy when dissipated on the surface of a large conductor and when dissipated on the surface of a comparatively small or easily dissipated conductor. When dissipated on the surface of a large conductor, — a conductor so strong as to resist the explosive effect, — damage results to objects around. When dissipated on the surface of a small conductor, the conductor goes, but the other objects around are saved

A Typical Case of the Action of a Small Conductor.

Franklin, in a letter to Collinson read before the London Royal Society, Dec. 18, 1755, describing the partial destruction by lightning of a church-tower at Newbury, Mass., wrote, "Near the bell was fixed an iron hammer to strike the hours; and from the tail of the hammer a wire went down through a small gimlet-hole in the floor that the bell stood upon, and through a second floor in like manner; then horizontally under and near the plastered ceiling of that second floor, till it came near a plastered wall; then down by the side of that wall to a clock, which stood about twenty feet below the bell. The wire was not bigger than a common knitting needle. The spire was split all to pieces by the lightning, and the parts flung in all directions over the square in which the church stood, so that nothing remained above the bell. The lightning passed between the hammer and the clock in the above-mentioned wire, without hurting either of the floors, or having any effect upon them (except making the gimlet-holes, through which the wire passed, a little bigger), and without hurting the plastered wall, or any part of the building, so far as the aforesaid wire and the pendulum-wire of the clock extended; which latter wire was about the thickness of a goose-quill. From the end of the pendulum, down quite to the ground, the building was exceedingly rent and damaged. . . . No part of the aforementioned long, small wire, between the clock and the hammer, could be found, except about two inches that hung to the tail of the hammer, and about as much that was fastened to the clock; this rest being exploded, and its particles dissipated in smoke and air, as gunpowder is by common fire, and had only left a black smutty track on the plastering, three or four inches broad, darkest in the middle, and fainter towards the edges, all along the ceiling, under which it passed, and down the wall."

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CONTENTS.

AN EXERCISE IN GEOLOGY. G. D. Swezey . . 85
THE BASIS OF SPELLING REFORM. A. Melville Ball . 86
PRESSURE OF THE VAPOR OF WATER. H. A. Hazen . 87
CURIOUS IROQUOIS POTTERY. W. M. Beauchamp . 88
HOW ALUMINIUM IS OBTAINED FROM ITS ORES . . 89
CURRENT NOTES ON CHEMISTRY.—VI. Edited by Charles Platt 90
LETTERS TO THE EDITOR:
COMMENT ON "A NEW THERMO-ELECTRIC PHENOMENON." W R. Turnbull 91
BIRDS SINGING ON THEIR NESTS. Henry Hales . 92
EFFECTS OF WEATHER ON SCIENTIFIC WORK. T. D. Crothers 92
A FREAK OF INFLORESCENCE. Lucy A. Osband . 92
MAYA HIEROGLYPHS—A CORRECTION. H. T. Cresson 92
THE NATIVE CALENDAR OF CENTRAL AMERICA AND MEXICO. D. G. Brinton 92
MINING EXHIBITS AT CHICAGO. Geo. L. English 93
BOOK-REVIEWS 93
NOTES AND NEWS. 95

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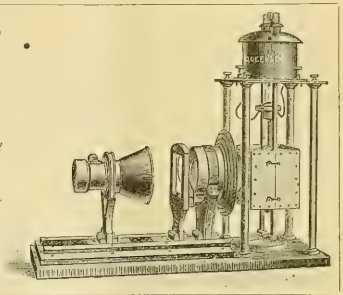

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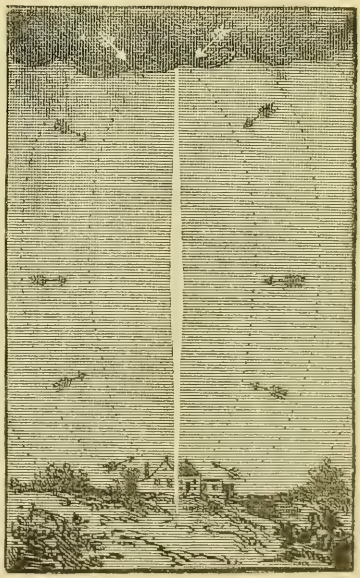
PROTECTION FROM LIGHTNING.

IS it not true that, in a vague way, the usual conception of the cause of damage by lightning is that something (in past ages a "thunderbolt") comes down from the thunder cloud to do the damage? Is it not true that since damage is done by lightning we should seek the mass of matter in which this energy must exist just before the flash? Is it not equally true that since Faraday's time we have known that this energy exists in the column of dielectric (mainly air) extending from the cloud to the earth? Do we not know since Lord Kelvin's experiments that this energy exists in the air on account of a state of electrical stress, which stress cannot extend .0075 of a pound per square inch, and that consequently the amount of energy in each cubic foot of air cannot exceed about one foot-pound?

Knowing that the energy just before the flash exists in the column of air between the cloud and the earth, which column is indicated in the figure by the dotted lines, and that when the air "breaks down" and the flash comes this energy manifests itself mainly as heat along the central core of this column in what we call a flash of lightning, is it not evident that the energy must be transmitted in lines perpendicular to the lines of electrical stress, *i.e.*, in the main horizontally, indicated in the figure by the arrows?

From all this, which is a part of our current knowledge, it appears that the problem of protection from lightning is a problem in the dissipation of energy; that the energy to be dissipated, while we know it to be considerable, as broken masonry testifies, is but a small part of the whole involved in a flash of lightning, by far the larger part being dissipated as heat above the roofs of our houses. If the conditions can be so arranged, by the use of considerable masses of metal suitably placed, that there shall be no state of stress below the roof of the house, then there will be no energy to be dissipated below that level, and all will go well. But it is surely time that the problem of protecting buildings from lightning should be looked upon as one in energetics and that it should be appreciated that the energy present cannot be hocus-pocussed out of the way but must be dissipated in some harmless manner.

The deflagration of a pound or two of thin copper ribbon dissipates a large amount of energy, how much we do not know, but experience shows it is so large that too little is left to do other damage when a house is struck by lightning. This lightning protector, manufactured under patents of N. D. C. Hodges, Editor of *Science*, is sent prepaid to any address on receipt of $5.00 per 100 feet. The amount ordered should be sufficent to run lines of the protector from the highest to the lowest points of the building, at intervals of about forty feet. Any carpenter can put it on.



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QUERY.

Can any reader of *Science* cite a case of lightning stroke in which the dissipation of a small conductor (one-sixteenth of an inch in diameter, say,) has failed to protect between two horizontal planes passing through its upper and lower ends respectively? Plenty of cases have been found which show that when the conductor is dissipated the building is not injured to the extent explained (for many of these see volumes of Philosophical Transactions at the time when lightning was attracting the attention of the Royal Society), but not an exception is yet known, although this query has been published far and wide among electricians.

First inserted June 19, 1891. No response to date.

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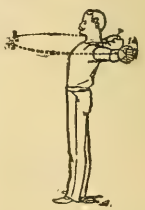

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SCIENCE

NEW YORK, FEBRUARY 16, 1894.

AN EXERCISE IN GEOLOGY.

BY G. D. SWEZEY, DOANE COLLEGE, CRETE, NEB.

A MOST profitable training to be had from the study of geology is found in the interpretation of geological maps and sections with a view to reconstructing the geography of the continent in various periods of geological time. Our text-books usually give the student such reconstructions ready made, but it is safe to say that they do not mean very much to the average student; he does not probably get farther into the matter than to wonder how anybody knows that there was an extended land mass in the Sierra Nevada region, for instance, during Palæozoic time when the geological map shows the region mostly covered with Jura-trias rocks.

As data for this exercise I compile, from as recent data as I have at hand, a geological map of the country and a considerable number of geological sections. For a blank map I use the map "Form C" of the United States Weather Bureau, 19×24 inches in size.

The geological map should be a simple one, omitting many small areas; it is not worth while, for example, to show the narrow lines of Cambrian and Carboniferous rocks bordering the Rocky Mountains; their presence will be disclosed by the geological sections; besides they would be rather misleading than otherwise, since they seem to imply that the Silurian and Devonian are there missing from the series. Nor should the intricacies of Appalachian geology be represented. I generally content myself with showing a very narrow line each of Cambrian, Silurian and Devonian bordering the Archæan area of this region on its western side.

I use one color for each period, as now recognized by the United States geologists, omitting, however, the Pleistocene or at least the drift deposits. For pigments I use the analin dyes, approximating as nearly as convenient to the colors adopted by the United States Geological Survey, as follows:

Neocene—Yellow analin tinted slightly with rosin.
Eocene—Yellow analin.
Cretaceous—Methyl green shaded with yellow.
Jura-trias—Methyl green.
Carboniferous—Blue analin.
Devonian—Gentian violet darkened with common ink.
Silurian—Gentian violet.
Cambrian—Rosin.
Algonkian—Yellow tinted with rosin.
Archæan—Bismark brown.

On the same sheet with the map is presented a generalized section across the continent, on the 40th parallel, showing the superposition of the rocks of the several periods, their relative thickness in different basins, their folding in mountain regions, their conformity or unconformity and some of the more extensive faults which the section crosses. This section along the 40th parallel happens to be an unusually instructive one, crossing, as it does, surface exposures of every formation, except perhaps the Algonkian, and revealing the geological history of our principal mountain systems; but in addition a number of local sections are needed to make clear the history of certain regions, especially where late formations entirely conceal earlier ones. I have represented sections across the Green Mountains and the basin to the east of them, across the Connecticut Valley, through one or more of the Great Lakes to show that they are erosion valleys, through the Black Hills, the Uinta range, the Texas Archæan and Algonkian, the Grand Cañon region, etc., etc. These sections should be on the same sheet with the map and numbered to correspond with lines on the map indicating their location.

Some of these sections must, it is true, be more or less hypothetical, but they should not be mere guesses; let the guessing be done, if it must, when we come to reconstruct the geography of the continent. Portions of the northwestern and southwestern United States are as yet so incompletely known that I do not attempt to include them in the map even.

Finally some lines of off-shore soundings should be drawn around the map to indicate where the real borders of the continental plateau lie.

In the first place each student should make for himself an exact copy of the map and sections. This will not be a very laborious task, as a blank map can be placed over the other against a window and the division lines copied through. By the process of drawing and coloring the map the student will get a better acquaintance with it than he could in any other way.

The classes are now prepared to trace the growth of the continent from period to period. Let them make at least one map showing the land and water for each period. Shade the land one color and leave the oceans and submerged portions of the continent blank; where the coast lines can be located with reasonable confidence, indicate them by the water-lines ordinarily used on maps; where they are quite hypothetical use dotted lines or some similar device; but let every student *make his map*, even though in places it must be largely conjectural. The smaller weather bureau map 9×12 inches will perhaps be better suited to this purpose.

I have been very much interested to see how, by this process, a geological map from being, to many a student, a meaningless patchwork of colors becomes significant and intelligible, almost a geological history in itself, in which the student can see in imagination not only the gradual extension of the continent southward from Canada during the earlier periods, but also the sinking archipelago in the west with only its higher summits finally peering above the engulfing seas.

I have suggested one map for each period; but there are some portions of the geological story so interesting on account of their widely changing conditions that several intermediate maps are most instructive: this is especially true of pre-Cambrian and early Cambrian times and also of the passage from Carboniferous through

Permian to Juratriassic times. For the former we are as yet poorly off for data, especially in Algonkian times; for lower Cambrian I send the student to Walcott's map in Bulletin No. 61 of the United States Survey, showing the occurrence of lower, middle and upper Cambrian deposits at various points; or better reproduce the map and show on it at the same time the Archæan exposures, so that it may be evident in what basin or valley each Cambrian section lies; then the mapping of the continent, first in earlier Cambrian and then in later Cambrian times, presents a very instructive picture to the mind's eye of the waters returning from their long retreat, after Algonkian times, into the ocean basins and gradually encroaching upon the continent, first filling the valleys along the borders, and finally invading the heart of the continent itself. The retirement of the waters in later Carboniferous and Permian times is an equally interesting spectacle.

Nor is the mere mapping of the land and water all that can be done. The question will arise as to what sort of a land it was: was it level or mountainous? How high did the Rocky Mountain islands and other lands rise above the sea? Such questions can be answered approximately at least by a study of the sections if they are carefully drawn. The student will discover, for instance, that the Archæan rocks of Nevada towered up high enough not to be submerged by the 30,000 feet or more of Palæozoic sediments that were deposited in the valleys to the eastward; in other words that mountains higher than any now existing lie buried under the modern Sierras. The student may represent these on his Palæozoic maps and indicate their gradually decreasing height from period to period.

Something, also, can be done at locating the old drainage systems of these early continents. In many cases it will evidently be safe to infer that the modern rivers are in the same old channels, especially in driftless regions; in other cases the pre-glacial history of rivers has been made out; a map of the pre-glacial drainage of the great lake region, like that in the *American Geologist* for Feb., 1891, for example, may be reproduced and hung on the wall, where it may be used in locating the probable course of the rivers of that region, in the various periods with which the class has to deal.

I wish that some one who is competent to do it would give us a handbook of elementary geology, which should consist largely in the presentation, by means of maps, sections, rock columns, tables and text, of such facts as the student could use in developing by laboratory methods his own "geological story briefly told."

THE BASIS OF SPELLING REFORM.

BY A. MELVILLE BALL, WASHINGTON, D. C.

MANY efforts have been made, and renewed from time to time, to correct the anomalies of English spelling; but, for the most part, these efforts have been resultless, except to intensify the prevailing sense of needed amendment. Strangely enough, the first requisite for any improvement in spelling has generally been lost sight of—namely the improvement of the ALPHABET. We have to write *g*, we have to write *h*, we have to write *n*, we have to write *s*, we have to write *t*, in thousands of cases where there is no *g*, *h*, *n*, *s*, or *t* to be pronounced. On account of a defective alphabet we are compelled to use unsounded letters to denote unrepresented sounds. For example, the consonant in the syllable *ing* has neither *n* nor *g* in its sound; the consonant in the syllable *ish* has neither *s* nor *h* in its sound; the consonants in the words *oath* and *they* have neither *t* nor *h* in their sounds; and these two sounds,—while as different from each other as *s* and *z*, *f* and *v*, *p* and *b*,—are both denoted by the same letters, *th*. With such glaring defects in the alphabet, any attempt to improve orthography by merely dropping redundant letters is but trifling with the subject. A workman must have appropriate tools, yet we expect our literary workman to dispense with a large proportion of his most necessary implements, and to spell forty sounds with little more than half that number of letters. We must commence our spelling reform by providing the means of writing our unrepresented sounds. Of these there are SIX, among consonants, as heard in the words

sing, *wish*, *pleasure*, *oath*, *they*, *why*.

When we shall have furnished the alphabet with representative letters for these elementary sounds it will be time enough to attend to the minor discrepancies in the writing of vowels. All the amendment that can be hoped for in the latter respect—without multiplication of new letters—will be brought about by the application of one rule, namely: OMIT ALL PHONETICALLY DISPENSABLE, OR SILENT, LETTERS. This rule will, without specific detail, take *a* from *head*; *e* from *have* and *give*; *i* from *friend*; *o* from *feoff* and *people*; *u* from *build*, etc. The rule has thus the advantage of simplicity and comprehensiveness, so that it may well take the place of the twenty-four rules of the philological societies, which only amount to the same precept "writ large."

Of the two classes of faults in spelling—deficiency and redundancy of letters—the former is by far the more serious and should be first rectified. Redundancies can be dropped at any time.

The one only drawback that can be urged against extension of the alphabet is that printers will require six additional types. But this objection is neutralized by the consideration that the trifling expense of additional types will be largely offset by the working economy of making six letters do the present duty of twelve.

The new consonant letters may be so designed that they will make but little alteration in the aspect of words, and so will be intelligible at a glance to every reader. The suggested forms introduced in WORLD-ENGLISH exemplify this fact, but in that system every word is made phonetic for "World" use. The present proposal limits inaugural improvement to the provision of letters for unrepresented sounds. Other improvements may safely be left to work themselves out by degrees, but there can be no radical improvement in spelling while we lack letters to represent one-fourth of the consonants in our language.

The attention of Congress has recently been again called to this subject; therefore the movement is opportune for its discussion. Let America take the initiatory step, and Great Britain and the English-speaking world will follow. The "initiatory step" will consist simply in an enactment that the Public Printer shall henceforth use prescribed forms of single letters to represent the six simple sounds enumerated above; and that he shall discontinue the use of the double letters now employed for the same purpose.

This is the true basis of SPELLING REFORM.

—Sydney H. Vines, Fellow of Magdalen and Sherardian Professor of Botany in the University of Oxford, is about to issue a "Student's Text-book of Botany," based upon Professor Prantl's "Lehrbuch der Botanik," but with the scope of the work so extended that, while retaining all that has made it of value to beginners, it will be more useful to those engaged in advanced study. The number of pages has been doubled by additions to all four parts of the book, but more especially to Part III., dealing with the classification of plants. The whole book, moreover, has been so revised as to render the present essentially a new and distinct work.

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PRESSURE OF THE VAPOR OF WATER.

BY H. A. HAZEN.

ONE of the more important facts needed in meteorology is the pressure of the vapor of water, commonly called "vapor pressure" for short. Until very recently Regnault had obtained the best values for this element. His method was to introduce a capsule of distilled water, from which all air had been expelled, into the vacuum of a barometer and there liberate the water. It is well known that this vapor will diffuse itself and absolutely saturate the space above the mercury. Its pressure will be exactly dependent upon the temperature and can be ascertained approximately by comparing the barometer reading with a perfect barometer. It is easy to see that many elements of inaccuracy are introduced in such an apparatus. Most of these have been eliminated by a most beautiful apparatus, designed and constructed by Prof. C. F. Marvin, of the Weather Bureau. I have made thousands of readings with it, and it is one of the most satisfactory instruments to manipulate I have ever seen. In this, the two barometers are dispensed with, but there are two vertical tubes connected at the bottom and partly filled with mercury. A bulb is attached to one of the tubes, and afterward the air is exhausted and vapor liberated by breaking a capsule of water previously inserted in the bulb. The heights of the mercury columns are read by means of a vernier. I found no difficulty in repeating again and again, and day after day, readings within .03 to .04 of a millimetre (.0012 to .0016 in.). A full description of a perfected apparatus will be found in the Annual Report of the Chief Signal Officer for 1891, pp. 351–383.

In January, 1890, I carried the apparatus with great pains to Northfield, Minn., and there made a series of readings, the results of which were published in the Annual Report of the Chief Signal Officer, 1890, pp. 658–662. Perhaps the most interesting result obtained was a marked difference in vapor pressure when the temperature of the water was different from that of the vapor. This is best shown in a series of comparisons of water at freezing and a portion of the vapor above it at different temperatures, as follows:

Water } Vapor Temperature Fahr.	32	42	52	62	72	82	92	102	112
32°. } Vapor pressure	4.00	4.57	4.55	4.53	4.50	4.48	4.44	4.39	4.33

Most of the vapor in these experiments was at the temperature of the liquid.

It should be noted, in passing, that Professor Marvin did not obtain any effect of this kind, and in his results it is ignored.

There has just come to hand a very interesting paper, by Prof. Geo. W. A. Kahlbaum, of Basel, Switzerland, in "Archives des Sciences Physiques et Naturelles," Geneva, vol. 31, p. 49. In this paper the author shows very clearly that there is a marked effect depending upon the difference in temperature between the liquid and the vapor above it. The only portion of this investigation needed for our purpose is that relating to the vapor of water. To present the facts in the best possible shape for comparison I have placed in the following table values of vapor pressure at different temperatures by various experimenters. In the first column is the temperature of the vapor in degrees Fahr., and in the succeeding columns the pressure in millimetres of mercury, as observed by Regnault, computed by Broch from Regnault's observations, observed by Kahlbaum, by Professor Marvin, by myself, and as determined by the Royal Society of England, probably from the results of various observers, but this is a mere inference.

VAPOR PRESSURE IN MILLIMETRES AT VARIOUS TEMPERATURES.

(1) Fahr.	(2) Reg.	(3) Broch.	(4) Kahl.	(5) Marvin.	(6) Hazen.	(7) Roy. Soc.
0	1.01	1.14		.97	1.11	1.30
5	1.32	1.44		1.25	1.38	
10	1.72	1.81		1.60	1.72	1.98
15	2.18	2.25		2.06	2.18	
20	2.78	2.79		2.61	2.75	2.95
25	3.45	3.43		3.31	3.44	
30	4.25	4.22		4.17	4.25	4.37
35	5.17	5.15		[5.24]	5.17	
40	6.29	6.26			6.28	6.38
45	7.60	7.58			7.62	
50	9.16	9.14	9.36		9.15	9.17
55	11.09	10.97	10.97		10.91	
60	13.15	13.22	13.13		13.05	13.11
65	15.68	15.65	15.67		15.59	
70	18.62	18.59	18.47		18.53	18.36
75	22.04	22.01	21.76		21.96	
80	25.99	25.96	25.67		25.88	25.53
85	30.56	30.52	30.51		30.30	
90	35.81	35.76	36.12		35.41	35.05

A comparison of (2) and (3) shows a tendency to error at very low temperatures in the mathematically computed results. I do not see how we can go back of the original record in such case. The values in (4) agree fairly well with those in (2), except at 50°, 70, 75 and 80. It is possible there is a misprint, otherwise there would seem to be some error in the values. It would be very gratifying if we had the results at the lower temperatures. Column (5) gives results which are lower than those in (2), and as the observations were all at temperatures of 70° for some of the vapor, it would seem, according to the law determined by two independent observers, that these values are all too small. Perhaps Regnault's work was done at temperatures of water, or ice, and vapor approximately the same, and, if so, his results may be very nearly correct, so far as this point is concerned. In column (6) all the values are reduced to a common temperature of water and vapor. These agree remarkably with column (2) till we reach 85°, when there is a falling off. It was found rather difficult to manipulate the apparatus at this high temperature, and it is also probable that whatever errors existed in the apparatus were largely increased at these higher temperatures, so that I do not insist upon the absolute accuracy of the results in (6) above 85°. It is a little singular that there should be this rather rapid fall in my values as compared with Regnault's, and I am confident they are not due wholly to errors in (6). There is another point of great interest in this connection. Column (4) is supposed to have this effect entirely eliminated, but that has a very sharp fall as compared with (2) at 70° $-.15^{mm}$, 75° $-.28^{mm}$, 80° $-.32^{mm}$, then a rise at 90° $+.31^{mm}$. It seems very difficult to account for these jumps in (4), and it may be that there is some error

at the highest temperature given. Column (7) is interesting as showing the extreme difficulty there is in securing reliable results in work of this kind. At the lowest temperature this gives .29^{mm} higher than (2); at 50° they agree, and at 90° column (7) is .76^{mm} lower than (2), and .36^{mm} lower than (6). It seems to me the work has now been narrowed within pretty small limits, and but little more is needed to give us an absolute standard of values of this important element, which enters into so many discussions in meteorology. I hope shortly to obtain values from Professor Kahlbaum at very much lower temperatures.

CURIOUS IROQUOIS POTTERY.

BY W. M. BEAUCHAMP, BALDWINSVILLE, N. Y.

THE common earthenware of the North is well known, and its styles of ornament are simple. Incised lines, rows of dots, notches either pinched or cut, impressions of corn or grass, small circles made by a hollow bone, are among these, but there are others which are almost unique. Hough speaks of rude attempts at human faces in pottery along the St. Lawrence River, and these appear in a more distinct manner on some Mohawk and Onondaga sites. On these they occur from about A.D. 1600 to 1640, apparently reaching their proper territory at the time of the migration of these two nations, which may have been a little before the earlier date here given.

The earliest hint of such attempts which I have seen in New York is in the arrangement of three dots to represent the eyes and mouth. Such examples occur in Jefferson County, N. Y., and in one of these the elliptical and horizontal indentations are placed inside four lines, arranged as a diamond, at the lower angle of the vessel. The point of the diamond forms the chin. In a similar one the boundary lines form a pentagon, with the apex above. Still another has a horizontal line for the chin, as in the last, and mostly the same general form. About this are lines and notches, and the three circular impressions were formed by a hollow bone. I have a pottery rim much like these, said to be from a small burial mound near Columbus, Ohio. In this, however, the small elliptic indentations have their longest diameter vertical. There are no distinct bounding lines, though two lines run parallel with the notched rim, and the general decoration is of vertical and diagonal lines.

In the more advanced types the body and limbs, when present, are almost always made of raised bars of clay, which are crossed by grooves. Rarely these bars appear without human faces. In the Canadian Institute Report, 1891, fig. 2, is the representation of a fine vessel from Lanark County, Canada, which has several such bars symmetrically arranged. I picked up a rim on the Seneca River, N. Y., which had two such raised bars, placed vertically and rising so far above the rim as to be continued within. They are each two inches long.

On one of the two early Mohawk sites I know of no earthenware of this description, though the general style is very bold. On the other I found a fragment of the largest figure that I have yet seen. It was broken through part of the angle, and though the body was gone its impress remained. One arm is nearly perfect and is 3.5 inches long. The vessel was ornamented with lines and notches, and this was continued below the projection. Usually this class of pottery has no ornament on the lower part. I figured a very elaborate specimen from the same early site. The face reached the top of the angle, and the feet to the lower edge of the projecting top. The limbs were less conventional in arrangement than usual, and there were many parallel and intersecting lines. The figure was but slightly raised, and may not have been made like the others. No European articles have been found on this site except two long and cylindrical brass beads.

A site in a like elevated position near the same stream is a little more recent, containing iron articles, copper saws of Mohawk make, unfinished bone combs, etc., and it is several miles nearer the river. It yields fragments of many of these vessels. In one the angle is low, and the small face is close to the rim. There is a curious arrangement of dots and lines. Another has a large face, with general ornaments of lines and notches. The most curious one I have seen came from this spot. The figure is rather large, and while one extended arm has the left hand raised, the other has the right hand turned down. Fingers and toes are also represented, and the general surface has some incised lines. Another with a small face and body has circles for eyes, with a raised surface in the centre of each.

On a still later site a few miles east of this I found an angle of a vessel with a projecting head above the level of the rim. The face is round and flattened, with very wide eyes and mouth, suggesting an ape. The body forms a single bar with the usual cross indentations, and lines slope away from it on either side. I have seen nothing like it. In the same place I found another fragment, one arm and part of the body remaining, and on these were deeper notches than usual, of an elliptic form. The face was broken off from another. It was placed below a dotted angular rim, and the body was slight. In this one lines of dots represented the arms instead of bars. Still another preserved the face and body, the latter in two vertical lines, whereas it is usually in one. At a site not far from this the face at the angle of a broken vessel was broken off, and the legs reached only to the edge of the upper projection. The body of this was also double, and the arms were nearly perpendicular, but not symmetrically arranged. They had fingers. All these were from the north side of the river.

I have a figure of but one on the south side, and think the early clan there made few or none. This one had a curious face and body. Three circular dots represented the eyes, and the shoulders were distinctly rounded. Of a few Mohawk specimens I made no figures.

The Onondaga forms are remarkable in the frequent occurrence of the detached faces, especially on their earliest site. The range in time is about the same as the Mohawk, and all have been found within a distance of six miles except one specimen. The detached faces are of many sizes and features, but a broad, good natured face was quite a favorite. Usually the face is placed squarely on the vessel, but sometimes it has an oblique position. One has a large nose and projecting forehead, and this, like most of the others, is from the site occupied about 300 years ago. Excepting one already noted this has the only example of the perpendicular raised bars which I have seen here unconnected with heads. Among the Mohawk specimens the legs usually end with the projecting upper part. Here they often extend below. One of this kind has the arms represented by lines of dots. A face below a notched rim shows traces of arms but no body or legs. The parallel legs of another are over two inches long. One round face has a broad body, which has no lines across it, but they may have been worn away. Another body is very broad and has lines; the extremely short incurved legs end in long toes in this example.

Several miles southwest of this is the next site in point of time. One fragment has a very high angle, with the head, body and arms on the upper part, which is decorated with lines and dots. Two slender legs appear on the sharply receding lower part. Another has a twisted face

and mouth under a notched rim. One detached face has much the character of some of the heads at Hoclulago, but the Onondagas seem to have made some terra cotta articles merely as ornaments.

Two other later sites, not far off, supply some more articles of this kind, but it is needless to describe all of these. Quite a number have been passed over now. On the earliest of these Onondago sites are occasionally found some large and curious clay pipes, with from four to five grotesque faces encircling the top of the bowl, while others intertwine all down the curving sides even to the mouthpiece. I have seen them nowhere else.

Of this pottery one fragment with a face at the angle was recently found on a fishing site near the head of Onondaga Lake. It is of interest as showing that the Onondagas even then visited the lake, though their homes were far away. It is interesting, too, to find that the Mohawks and Onondagas, the real founders of the Iroquois League, both had this unique pottery for a short time three centuries ago, and that it has not yet been found in the homes of the other Iroquois.

HOW ALUMINIUM IS OBTAINED FROM ITS ORES.

Aluminium is now so rapidly growing in demand with the cheapening of the metal that it attracts more or less popular attention. In the form of clay the metal is all around us, but this ore is too poor in the metal and too difficult of working to make it a profitable source of supply. Corundum is the oxide and theoretically nearest the metal from a metallurgical point of view. Indeed, the metal has been extracted from this mineral on a small commercial scale, but the supply is too limited.

The metallurgy of the aluminium is theoretically the same as iron, that is, the compound used for extracting the metal is in each case an oxide. The oxygen in both cases is removed by carbon. The facility of carrying into practice the extraction of the metal is entirely different. In an ordinary blast furnace the carbon of the coal or coke easily extracts the oxygen from the iron ore, so that a pound or two of coal produces a pound of metallic iron. The oxide of aluminium defies such easy processes, and requires a temperature vastly greater than the fiery iron furnace. This is obtained by electric currents, and a process of electro-metallurgy is adopted. A trough is lined with gas carbon. In this, cryolite to the extent of 500 pounds is placed. Into this press, enormous electrodes are inserted, and the heat melts the cryolite, which is not decomposed by the electricity. With this fused mineral, about a third of its weight of oxide of aluminium is mixed, and it is soon dissolved. In this condition the aluminium compound is decomposed, the oxygen being removed at the expense of the carbon electrodes, and the molten particles sink in the cryolite. As the cryolite (fluoride of aluminium and sodium) is not consumed, the operation is continuous. However, the affinity between the metal and oxygen is so great that not merely the carbon of the electrodes is consumed, but about 75 pounds of coal are needed to develop horse-power to produce electricity enough to decompose the oxide.

From the method pursued, we see that the ore most available is that nearest approaching an oxide and rich in the metal. Of the natural compounds occurring in large quantities, beauxite is the most important. This is essentially a hydrated oxide of aluminium, but with usually an admixture of oxide of iron and frausilica. A high grade ore contains 60 per cent of alumina, only one or two per cent of each of the other constituents, and the balance is water. In this country the beauxite occurs in Georgia, Alabama and Arkansas. It is from the recent volume on the Paleozoic Belt of Georgia, by Dr. J. W. Spencer, that we derive the materials for this notice. This report is the most exhaustive treatise upon beauxite which has appeared in this country. The mineral occurs as masses of small concretions in great products in the Knox dolornite (the lowest formation of the Lower Silurian system). Where it is formed, the calcerous matter has been leached out of the impure limestone, leaving a great mass of a peculiar siliceous clay or loam, which is sometimes 200 feet thick. This represents that as much as 2000 feet of limestone have been removed from the region, which has been exposed to atmospheric degredation for long geological ages. As the alumina has resisted solution, a process of concentration has gone on so that the accumulations make themselves conspicuous. The ore always occurs in proximity to brown iron and manganese ores. The author explains their occurrences as having been brought down in solution by streams and deposited in lagoons, in which the limestones were also forming. The author gives us here an interesting chapter on chemical geology, without saying so in his treatment of the origin of the beauxite. Under the conditions of occurrence ferric oxide often replaces a portion of the alumina, sometimes to the extent of twelve or fifteen per cent. This, however, is no injury, for in preparing alumina for furnace uses a valuable bye-product is obtained. Silica may sometimes reach 20 or 30 per cent. In this case, the mineral must be considered more or less a mixture of beauxite and clay. Amongst the beauxite, iron and manganese deposits, great pockets or "horses" of clay, or often kaolin, are frequently seen. When the silica is present in such quantities the mineral becomes too poor to be of use. For making alumina the beauxite is fused with soda, from which mass the pure alumina is extracted. With the visible supply of beauxite and greater economy in the power consumed, we may hope before very long to see the metal at twenty-five or thirty cents a pound, when its uses in the arts will be enormously increased.

—When we examine the total number of books that have for their subject an Oriental country we are surprised to find how large a proportion of them have been written by travelers who were there for a comparatively short period, who did not understand the language of the people they describe, and whose knowledge must, consequently, have been acquired mainly at second-hand. It is a pleasure, therefore, to find in Miss Adele M. Fielde's forthcoming volume—"A Corner of Cathay"—a graphic record of original research concerning the life of the Chinese, by one who lived among them for twenty years, and whose familiarity with their language enabled her to enter into their modes of thought, and to ascertain from themselves the reasons for their peculiar and amazing customs. As an inmate of native households she possessed peculiar facilities for a study of their life, domestic, social, and intellectual, from the question of the legal status of the women to the curious games played by the children. In her illustrations she was aided by a native artist of wide local fame, and his pictures, as winsomely guiltless of perspective as were those of the early Italian artists and as charming in tint as Pekinese enamels, are skilfully reproduced in colors and present a new feature in American illustration. The name of the book is taken from the populous and picturesque region about Swatow, in the southeastern corner of China. It will be published by Macmillan & Co.

CURRENT NOTES ON CHEMISTRY.—VI.

(Edited by Charles Platt, PhD., F.C.S.)

SILICON CARBIDE.

CARBIDE of silicon, or "carborundum,"[1] has already become a familiar term, and the material is now upon the market as a formidable competitor of the highest grade abrasives. It is interesting to note some of the chemical aspects of this substance as given by Dr. O. Mühlhæuser. To obtain the pure compound corresponding to the formula SiC the crystals are heated to dull redness in oxygen, boiled with potash solution, washed, digested with hydrochloric acid, again washed, and finally treated with hydrofluoric and sulphuric acids. It is insoluble in all acids, but is attacked by molten alkalis and by hot ferric oxide and, when very finely divided, can be slowly burned in oxygen. Its specific gravity is given as 3.22 at 15°C, but the fine powder will remain suspended in water for months. The following suggestions are made for analysis: The powder obtained by trituration in an agate mortar is submitted to elutriation and the carbon determination made with that portion which remains in suspension after five minutes. The carbon is best estimated by combustion with twenty parts of lead chromate, the addition of potassium dichromate causing the oxidation to proceed with explosive violence. The silicon is determined by fusion with potassium sodium carbonate for about six hours, during which time the heat should be increased very gradually. A very pure specimen gave by analysis: Carbon, 30.2 per cent; silicon, 69.1 per cent; oxides of iron and alumina, 0.46 per cent; lime, 0.15 per cent; magnesia, 0.09 per cent.

H. Moissan has produced the carbide by dissolving carbon in fused silicon, but states that it can be much more easily prepared by heating in an electric furnace a mixture of twelve parts of carbon with twenty-eight parts of silicon. It is also produced by heating carbon and *silica* in the electric furnace or by allowing the vapors of carbon to come into contact with vapor of silicon, when it is obtained in almost colorless, very hard and brittle, prismatic needles. Moissan gives the specific gravity at 3.12, which is also that determined by Professor J. W. Richards. According to Moissan, the carbide is not affected by oxygen at 1000°C, nor when heated in air by a Schlœsing's blowpipe. Sulphur vapor at 1000° is also without action, while chlorine attacks the compound very slowly at 600° and rapidly at 1200°. Fused potassium nitrate, or chlorate, boiling sulphuric acid, nitric acid, and hydrochloric, aqua regia, and mixtures of nitric and hydrofluoric acid are all without action. Fused lead chromate oxidizes the carbide, but repeated treatment is necessary to obtain complete combustion. Fused potassium hydroxide gradually converts it into potassium carbonate and silicate. Mühlhæuser has also described a boron carbide obtained by heating a mixture of boric anhydride with carbon in the electric furnace. A graphite-like mass is obtained, which after further heating in a platinum crucible and boiling with acids yields, on analysis, BC, or B_2C_2. It is described as a black powder having similar properties to graphite, burning with difficulty in oxygen, insoluble in nearly all of the usual solvents and decomposed by fusion with alkali. It is significant that the Carborundum Company are about to increase their capital stock, and that among other recent orders one has come from London calling for $10,000 worth of material.

FORMATION OF PRECIOUS OPAL BY THE ACTION OF HYDROFLUOSILICIC ACID ON GLASS.

PROFESSOR G. Cesàro, of the University of Liége, describes in the Bulletine of L'Académie Royale de Belgique the formation of precious opal and other substances by the action of hydrofluosilicic acid on a glass-containing vessel. The glass was attacked very unequally, the upper portion, that above the level of the liquid, being acted upon most strongly, with the production of cellular cavities containing a white translucent substance. In these cavities and also attached to the bottom of the flask were likewise found beautiful, limpid crystals of hexagonal form with others, unattached, which were apparently tetragonal. The opalescent mass was built up of concentric layers, which were easily separated and which produced fine iridescent effects. This substance proved to have the composition, silica, 90 per cent; water, 10 per cent; corresponding precisely to the precious opal of Hungary and from the chemical point of view to the polysilicic acid, $3\ SiO_2 . H_2O$. The formation of this opal is easily understood from the reaction:

$$6\ SiO_2 . Na_2O . CaO + 2\ H_2SiF_6 = Na_2SiF_6 + CaSiF_6 + 2\ (3\ SiO_2 . H_2O)$$

The hexagonal crystals found by their chemical and physical properties were determined as fluosilicate of sodium, Na_2SiF_6. The crystals give in converged light a uniaxial interference figure; they are negative in character and show a weak double refraction. The index of refraction for the ordinary ray is 1.300 and for the extraordinary ray 1.296. The remaining crystals, spoken of as apparently tetragonal, were determined to be biaxial and orthorhombic ($\frac{a}{c} = \sqrt{3}$), consisting of a soluble potassium fluosilicate. Finally in the liquid was found a fluosilicate of calcium. It will be seen that both the fluosilicate of calcium and of sodium, as well as the opal itself, are explained in the reaction above given.

These experiments recall the historic ones of Daubrée in Paris, who, by superheated water alone, altered a glass-containing tube with the production of hydrated silicates resembling zeolites (Pectolite?) and of an alkaline silicate in solution, together with innumerable colorless, bipyramidal crystals of quartz, minute spherulites, microlites and even a green pyroxene (Diopside?).

INERTNESS OF QUICKLIME.

IT is now a well-known fact that in the absence of moisture many elements and compounds which ordinarily react upon each other readily and even with explosive rapidity are rendered inert. Thus mixtures of oxygen and hydrogen if perfectly dry can not be exploded by the electric spark. Many chemists are now working on these lines, and all contributions are of interest in extending the experimental data. Mr. V. H. Veley has already shown in the Journal of the Chemical Society of London that quicklime does not combine to an appreciable degree with carbonic or sulphurous acids at temperatures below 300°C., and now in a more recent paper he has investigated the reaction between the same substance and chlorine. The result of Mr. Veley's experiments is to confirm the observation of others, his conclusions being, first, that dry chlorine does not combine with dry lime at ordinary temperatures to form the so-called bleaching powder; second, that no appreciable chemical change is observable between these two substances below a temperature of 300°, when a partial replacement of oxygen by chlorine takes place, the conditions being analogous to that of baryta and chlorine not specially dried and at ordinary temperatures. It seems probable to the writer that Veley's method of "drying" is the real explanation of the slight reactions obtained below 300°, in other words that *no* action would take place below that temperature were the chlorine and lime *absolutely* dry.

BARIUM AND STRONTIUM IN SILICATE ROCKS.

AT a recent meeting of the Geological Society of Washington, and later at the Baltimore Meeting of the American Chemical Society, Mr. W. F. Hillebrand presented a

[1] W. R. Blake in *Science*, XXII., 554, p. 141.

valuable series of papers on the widespread occurrence of barium and strontium in the silicate rocks, with methods for the determination of these elements in small amounts. Mr. Hillebrand also deplored the laxity existing in rock analysis and brought forward a strong appeal for greater completeness in the future. The papers are of extreme interest and hardly permit of abstract but can be found in full in the February Journal of the Chemical Society.

THE EXAMINATION OF BEESWAX.

MR. LYMAN F. KEBLER has recently published the results of an investigation of commercial beeswax, his general conclusions being as follows: He finds the beeswax upon the market to be adulterated to the extent of 50 per cent, while in the English markets this adulteration may even reach 66 per cent. The melting point varies from 62°–74°C. It is raised by adding carnaüba wax, stearic acid, certain mineral waxes and paraffin, and is lowered by China wax, Japan wax, cacao butter, resin, tallow, spermaceti, vegetable wax, etc. On the other hand the melting point is apparently unaltered when suint wax and certain of the mineral waxes are used. The specific gravity of the pure wax varies from 0.960 to 0.973, and this appears to be greatly influenced only by resin, carnaüba wax and certain mineral waxes, which raise it, and by paraffin, which lowers it. The "acid number" ranges from 19–21 mg. of potash per gramme of beeswax. Stearic acid resin and suint wax increase, while carnaüba wax, mineral wax, cacao butter, paraffin and spermaceti decrease the acid number. The "ether number" varies from 73–76 mg. of potash per gramme of beeswax and is increased by China wax, Japan wax, cacao butter, tallow and vegetable wax. It is unaffected by by addition of carnaüba wax but is lowered by mineral wax, paraffin, resin, stearic acid, etc. It must be noted in this connection that wax bleached by certain chemical agents may have on either number as high as 84 and yet be pure. The percentage of iodine varies from 8–11, but here also certain bleaching agents, such as chlorine, destroy the value of this test. Paraffin, mineral wax and stearic acid lower the percentage, while cacao butter, resin, suint wax and tallow increase it. The volume of hydrogen (53–57.5cc) evolved from one gramme of beeswax and the percentage (12.5–14.5 per cent) of hydrocarbons evidently are the most reliable data securable, the former being vitiated by all adulterants excepting tallow, and the latter by all except suint wax. The author gives a resumé of the best methods employed with many references to the literature.

BUTTER NOSTRUMS.

VARIOUS nostrums for increasing the yield of butter have long been more or less secretly upon the market, and notwithstanding their frequent exposure, they no doubt meet with considerable sale. Professor H. W. Wiley has again called attention to these frauds in Farmers' Bulletin No. 12, United States Department of Agriculture. It is claimed that from one pound of butter, one quart of milk and a little of the magic butter compound, two pounds of butter can be made! Analysis shows this compound to consist of common salt, coloring matter and a little pepsin or rennet. Such a mixture churned with the butter and milk merely coagulates the latter and allows of its incorporation, together with considerable water, into the resulting "butter" mass. Such outrageous adulteration can be easily detected by melting a sample in a test tube and comparing with a similar sample of genuine butter, the latter showing the fat in a clear limpid mass with only a small amount of water and a little curd, while with the former almost half of the whole volume will be a mixture of water, curd, and foreign substance. These compounds are retailed at from $2.00 to $2.50 a box of about two ounces.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as a proof of good faith.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The Editor will be glad to publish any queries consonant with the character of the journal.

Comment on "A New Thermo-Electric Phenomenon."

AN article has recently appeared in *Science*,[1] entitled "A New Thermo-electric Phenomenon." It is from the pen of W. Huey Steele, and has been copied and abstracted in several journals. Previous to seeing Mr. Steele's article, but not previous to its writing, I had made a few rough experiments along the same lines and had looked up the subject, historically, to see what had been already done.

From what I have been able to find out, in the course of my reading, it seems to me that Mr. Steele's phenomenon is not "new" at all, but is, perhaps, a slightly different phase of an old phenomenon first discovered by Becquerel in 1829.[2] Becquerel found that in a platinum wire, strained by a spiral and heated at one side of the strained portion, there is an electric current set up, and he thought that this was due to a difference in the propagation or movement of the heat to right and left of the heated portion. However, Magnus and Matteucci have shown that in a homogeneous metal the differences of temperature and of section are not sufficient to produce a current, and Becquerel's phenomenon should be attributed to a difference in the molecular state.

In addition, Sir William Thomson[3] has shown that thermo-electric currents were set up between the strained and unstrained portions of a single metal constituting a circuit; the effects in copper and iron being opposite, and the residual effect in each case being the reverse of the effect when the metals are temporarily strained. He also found the relations between hammered and unhammered iron and between brittle and soft iron.

To my mind these experiments are almost identical with those of Mr. Steele; practically no wire can be obtained that has not been through its own history of various strains. (The process of wire-drawing leaves the metal in a permanent state of elongation, and the residual thermo-electric effect, in that case, is the reverse of the effect which is induced by the force applied during the wire drawing.) As for the metals which he completely melted, I think there can be no doubt (from the very fact that "the effects are not always steady; in fact, they very seldom keep steady" and the *direction* of the currents keep shifting) that the melted metal was continually undergoing strains brought about by currents and strata of the metal shearing past one another, or, in other words, by a difference in the molecular state at different times. In addition there is probably, in the case of the melted metals, a large effect due to the thermo-electric action between the melted and solid metal that leads to the galvanometer, those at the opposite ends of the "clay tubes" being in different and continually changing molecular relations.

Becquerel must have obtained a considerable E. M. F. when he heated his platinum wire *to a white heat* and strongly affected a galvanometer of 1829. From these considerations I do not think that Mr. Steele's is a "new" phenomenon, and I think that everybody that reads his article and compares it with those of Becquerel and Thomson (which are far too extensive to even outline in this note) will agree with me.

In the opening lines of his paper Mr. Steele says that it has been "generally known that electric currents may be produced by heating a single metal, if there be any

[1] Nov. 10, 1893.
[2] Becquerel's "Traité d'Elec. et Mag.," Vol. I., p. 155.
[3] Phil. Trans., 1856, p. 711 et seq.

variation *in temper*, or if the distribution of heat be very irregular and the changes of temperature abrupt." However, this, to me, is only partial and does not touch the root of the matter—a molecular dissymmetry.

Perhaps this comment is totally uncalled for, but as there are already so many apparently different phenomena and "effects," in physics, it is well, when we can, to ascribe all modifications of any effect, that are manifestly due to the same principle, to that effect, instead of setting it down as a *new* phenomenon. W. R. TURNBULL.

Ithaca, N. Y.

Birds Singing on Their Nests.

IT is one of the encouraging hopes in natural science that taking anything for granted is giving way to facts. It is but a few years ago when one of our popular ornithologists said that birds were silent on their nests, else it would betray their nests. I had never seen anything in print to the contrary, up to 1886, when I discovered the nest of a white-eyed vireo from hearing the song proceed from one direction. I cautiously followed it, to find the bird on the nest. And here I may say I saw the male and female change places on the nest about noon every fifteen or twenty minutes; the male singing all the time on the nest as heartily as when off it. In February, 1892, I communicated these facts to the *Ornithologist and Oölogist*. It came out in "Bird Notes" in March, 1892, after which several correspondents from widely differing localities testified to hearing other species of vireos and the black-headed grosbeak of California singing on the nest.

In the April number of the *Ornithologist and Oölogist*, 1892, Clyde L. Keller writes: "It seems to be a trait peculiar to that family (vireos). I have observed both cassius and the western warbling vireo singing on their nests." In the next month, May, Mr. S. R. Ingersoll writes: "Let me add both the red-eyed and warbling vireos singing on their nests, especially the latter variety" (speaking of the eastern warbling vireo). This takes in so many of the vireos that it is probable all the family have this peculiarity. One may at first wonder that it was so long undiscovered. I think the solution lies in the fact that all these birds I hear of not being silent on the nests are all birds that have their nests well concealed. I had looked many years in vain for a goldfinch's nest before I could find one, till my ears helped me. Passing by a tree several times a day, I heard the voice of a female in the tree answering the call of a passing male. After searching some time I discovered her sitting on her nest, as well concealed as a goldfinch knows how to do it, so that the risk of betraying the nest is not great, with such birds as we now know to sing on their nests.

HENRY HALES.

Ridgewood, N. J.

Effects of Weather on Scientific Work.

VERY few persons recognize the sources of error that come directly from atmospheric conditions on experimenters and observers and others. In my own case I have been amazed at the faulty deductions and misconceptions which were made in damp, foggy weather, or on days in which the air was charged with electricity and thunder storms were impending. What seemed clear to me at these times appeared later to be filled with error. An actuary in a large insurance company is obliged to stop work at such times, finding that he makes so many mistakes which he is only conscious of later that his work is useless. In a large factory from ten to twenty per cent less work is brought out on damp days and days of threatening storm. The superintendent in receiving orders to be delivered at a certain time takes this factor into calculation. There is a theory among many persons in the fire insurance business that in states of depressing atmosphere greater carelessness exists and more fires follow. Engineers of railway locomotives have some curious theories of trouble, accidents and increased dangers in such periods, attributing it to the machinery. These are common illustrations and can be confirmed in the experience of all thoughtful observers. If some one would gather up reliable facts and tabulate them in this field, no doubt some laws of mental activity would be found. In an inquiry among active brain workers in my circle I find a settled conviction that many very powerful forces coming from what is popularly called the weather control the work and its success of each one. The psychology of the weather should be a most pregnant new land for study, and I would be pleased to hear from any one who may have some personal experience on this topic, for the purpose of making some future studies for the readers of *Science*.

T. D. CROTHERS, M.D.

Hartford, Conn.

A Freak of Inflorescence.

AMONG several hyncinths blooming in the window there is one which reverses the usual order of inflorescence. Its first spike of flowers was normal, that is, indeterminate, but the second began to bloom at the top, its lowest blossoms opening about the same time as the upper ones on the first spike. A spike on another plant began near the middle to open its flowers, and continued the process in both directions.

My observation of "late-blooming trees" has been that generally the second blossoming occurs only when the normal action of the tree has been in some way thwarted. A number of Duchesse pear trees blooming so early as frequently to get touched by frost are almost sure to bear clusters of blossoms the following August. A Siberian crab, in one of its off years, bore in July several clusters of flowers. These were larger than the ordinary flowers, and nearly as double as a Baltimore Belle rose. The summer flowers of the pear trees, on the contrary, are generally not so large, nor so many in a cluster as the spring flowers. LUCY A. OSBAND.

Ypsilanti, Mich.

Maya Hieroglyphs.—A Correction.

IN my first article on the "Interpretation of Maya Hieroglyphs by their Phonetic Elements" (*Science*, Dec. 15, 1893), p. 325, 2d col., 3d line from bottom, for 162 read 102; p. 327, 2d col., 5th line, for 123 read 125; 43d line, for 136 read 128, 129; p. 328, 1st col., 32d line, for mout read mouth; 4th line from bottom, for 84 read 86; 20th line from bottom, for 166 read 167; 21st line from bottom, for 165 read 166; fig. 35 should have been given in the illustration, but was omitted from the drawing sent. It is composed of three squares, similar to those given in fig. 128, and has the phonetic value xa v/s, sha v/s, cha v/s. H. T. CRESSON.

The Native Calendar of Central America and Mexico.

IN *Science*, Feb. 2, and also in the *American Anthropologist* for January, Dr. Cyrus Thomas publishes some observations on the above subject, bearing upon my recent work, "The Native Calendar of Central America and Mexico" (Philadelphia, 1893). As Dr. Thomas is evidently under some misapprehensions as to my statements, I beg to place them in a somewhat clearer light.

In the *Anthropologist* he undertakes to correct some of my quotations from the writings of Dr. Ed. Seler; but from his own words, it is plain that Dr. Thomas is very

imperfectly acquainted with the writings of that distinguished antiquary. For instance, the name of the fifth day in the Maya calendar is *chicchan*, which in one of his articles, published in 1888, Dr. Seler derives from *can*, serpent, and *chi*, to bite; but in a later paper, published in 1891, he retracts this etymology, and says, "Jetzt ist es mir zweifellos, dass es *chic-chaan*, d. h., 'tomado señal,' 'tomado aguero,' bedeuten soll." Dr. Thomas, unacquainted with the latter article, asserts that my quotations were not correct, and questions the translation. It is good for reviewers, as well as writers, to keep themselves acquainted with the current literature of their own special branches.

Dr. Thomas also objects to my interpretations of the Maya month names from religious ceremonies held at certain seasons, stating that it is "totally different from the method by which the names of the months of other calendars were obtained";—entirely overlooking the fact (for I cannot suppose he is ignorant of it) that the Nahuatl month-names are recognized by all to have been derived just in this way.

In his letter to *Science*, Dr. Thomas fails to grasp Mrs. Nuttall's theory. There is no fixed relation of the ceremonial year of 260 days to each civil solar year of 365 days; but in a cycle of exactly 37 solar years, 13,515 days, the two calendars coincide; and there is certainly some evidence that this cycle was noted and celebrated by both Mayas and Mexicans. We may well leave, however, further discussion of this intricate subject till the appearance of Mrs. Nuttall's work, now in course of publication by the Peabody Museum of Archæology.

The analogies which Dr. Thomas endeavors to point out in favor of a Polynesian origin of the calendar are not impressive. For instance, 8 months, 232 days, surely does not "correspond somewhat closely with the sacred period of the Mexican calendar," which was 260 days. Nor is it easy to see why it is such a "singular fact," that the Javanese, like the Mexicans, had a five days' week, since both employed the quinary method of enumeration. As to the Hawaiian system, Dr. Thomas is quite right in speaking of the accounts of it as "in evident confusion"; therefore the less we base analogies upon it, the more creditable will be our caution.

D. G. Brinton.

Philadelphia.

Mining Exhibits at Chicago.

The anonymous writer of the article entitled, "The Columbian and the Centennial Expositions," in *Science* of Feb. 2, we think unjustly criticizes the exhibits of the Mining Building. It is evident that the writer, in common with probably nine-tenths of the visitors, has passed judgment on the exhibit as a whole by examining merely those parts of it which were displayed on the ground floor. To a lover of educational features in the exhibit nothing could arouse greater regret than that so vast an amount of space on the ground floor was devoted to "great piles of rocks and ores utterly without system" and to the veritable storage of practically worthless, unlabeled material in expensive showcases, as for example in the wretched Mexican display. Your correspondent most justly condemns such waste of space, but when he attempts to score "the rest" of the exhibits, it is very easy to see that he overlooks the gallery exhibits, which in educational value far exceeded any at the Centennial. In Philadelphia exhibits of considerable interest, but of no scientific value, were scattered through several buildings; and the "Mining Annex," itself an afterthought, and added to the main building merely to supply the demand for space, contained little that was comparable even to the exhibits on the ground floor of the Chicago Mining Building. The elaborate, and on a whole excellent, metallurgical display in the west gallery, though defective, had no competitor at the Centennial; the most instructive Coke exhibit, the admirable abrassive exhibit, the large floor chart of the coal fields of the United States, and the collections of building stones all in the east gallery and the grand display of oils in the north gallery, the mere decoration of which we understand cost $65,000, are not even mentioned by your correspondent, and probably he never ascended the tiresome stairways which led up to the real mecca of the few who desired to study the educational exhibits in the Mining Building. Nor is mention made of the great systematic collections of minerals and rocks displayed respectively in the east and west galleries. It is worth noting that every specimen in two of these collections was labeled with its species, crystallographic form, chemical formula and locality, and so mounted as to clearly display the label, which in one collection was invariably a printed one. These systematic collections were unquestionably the best labeled, most complete and scientific, ever shown at any World's Fair. Two fine displays of gems in the rough and cut, in the west gallery, are also overlooked. It is easy to find fault, but far better, in our judgment, to discern merits, and as a mineralogist who visited the Centennial more than a score of times and spent six months at the Columbian Exposition, the opinion here expressed that the mining exhibit at Chicago far exceeded that at Philadelphia may coincide within the unwritten opinion of many a mineralogist.

Geo. L. English.

New York.

BOOK REVIEWS.

Histories of American Schools for the Deaf, 1817–1893. Edited by Edward A. Fay. 3 vols., octavo. Washington, D. C., The Volta Bureau.

The historical sketches contained in these goodly volumes were prepared for the Columbian anniversary, the enterprise having been first suggested in December, 1892. They give accounts of all the schools for the deaf that have been established in the United States, Canada and Mexico, most of the histories having been prepared by the heads of the various schools or by persons designated by them, several of the writers being deaf themselves. The different articles of which the work consists are printed and paged separately, the printing in many cases having been done by pupils or graduates of the schools, and the volumes are profusely illustrated with portraits and other pictures. Most of the schools are public, and supported in whole or in part by the state; but private and denominational institutions are also included, the whole number of schools dealt with being seventy-nine in the United States, seven in Canada and one in Mexico. Besides the histories of the various schools, these volumes contain an introduction by the editor, an account of several conferences of the instructors and also of the American Association to Promote the Teaching of Speech to the Deaf, together with many statistical and personal items pertaining to the general subject.

Of the schools whose origin and history are here recounted, the greatest interest naturally attaches to the earliest ones and to those which at a later time introduced the system of oral teaching. The editor in his introductory note alludes to the first establishment of the European schools for the deaf, which were the models of our own; and the opening chapters of the first volume describe the founding of the first two American schools, the American Asylum at Hartford, which was opened in 1817, and the New York Institution, which originated independently the following year. The remainder of the

work tells what progress has been made since, both in the establishment of schools and in improving the methods of teaching. The difficulty of teaching language to the deaf has made it necessary to confine the instruction for the most part to the elementary branches; but the higher education has been given to many pupils, and as the time for instruction has been lately increased by admitting the pupils at an earlier age, the opportunities for higher education are now much improved. Special care is taken in many of the schools to train the pupils in some mechanical art, so that they may become self-supporting; and these measures have been attended with gratifying results.

The system of oral teaching and lip-reading, though long practised in Germany, was not introduced into this country until 1867, when the first school to employ it, the Clark Institution at Northampton, Mass., was opened under the presidency of Mr. Gardiner G. Hubbard. A few years later Mr. Bell adapted his father's system of visible speech to the instruction of the deaf, and under his enthusiastic advocacy oral teaching has rapidly grown in favor, and is now employed in a large percentage of cases. At first, indeed, it was opposed even by some of the ablest teachers, who believed it would be detrimental to the pupils themselves; but experience has so shown that, for many pupils it is really the best method. Besides oral teaching, many other improvements have been introduced from time to time, until now the American schools for the deaf are equal to any in the world.

Of the Canadian schools described in the third of these volumes, several are private Catholic institutions, and their history is written in French; but the Canadian governments have not neglected their duty in the matter, and the deaf children of the provinces are now as well cared for as our own. Mexico is far more backward, only one school having yet been established; and much remains to be done to bring that country up to the level of her northern neighbors. For further details of the work described in these volumes we must refer the reader to the books themselves, and we are sure that he will rise from the perusal with a fuller appreciation of the good which the schools for the deaf are doing, and with the best wishes for both teachers and pupils.

Die Ruinenstatte von Tiahuanaco. By A. Stübel and M. Uhle. With one chart and forty-two plates. Breslau, C. T. Wiskott, 1892.

In the present work the learned authors have given the results of Dr. Stübel's investigations at Tiahuanaco, together with an exhaustive presentation of what is known about the history and traditions connected with the ruins which have attracted so much attention since the earliest times. The amount of information collected by Dr. Stübel during a stay of a little more than a week is really astounding. His measurements give us for the first time an adequate idea of the curious stone carvings and architectural pieces which have been described by D'Orbigny, von Tschudi and Squier. We also find here for the first time accurate reproductions of the interesting reliefs which are found on the façade of the large monolithic gateway. Besides these figures illustrating the ruins which were investigated by Dr. Stübel, the book contains a large map and a panorama illustrating the situation and the scenery in which the ruins are found. It was an exceedingly difficult task to interpret the meaning of the curious stone carvings which showed plainly that they were intended for architectural purposes, but which were scattered about on the site of the ruins. The authors have succeeded in showing clearly which way the stones were intended to be joined together, and have succeeded in constructing by means of models of these stones a façade figured on Page 38 of the work, which has certain analoga among the known remains of ancient Peruvian civilization.

In the discussion of the probable origin of the ruins the authors have reached the conclusion that the ancestors of the Aymara were probably their builders. The large and interesting figure over the gateway of Tiahuanaco is interpreted as the Deity of Light.

It must be added that the printing and the plates of the work are beautifully executed. The work ranks in importance with the former contributions from Dr. Stübel on the ancient civilization of South America.

Science and Education. By Thomas H. Huxley. New York, D. Appleton & Co. $1.25.

This, the third volume of Professor Huxley's "Collected Essays," consists of a number of papers and addresses, most, if not all, of which have been published in some form before. The first one, on Joseph Priestley, is commemorative of a prominent worker in science and other departments, and will interest those who like to trace the history of knowledge and opinion. The remaining essays deal with various aspects of the educational problem, especially in its relations to pure and applied science. Some of them are devoted to general education, both elementary and higher, while others discuss the more special topics of medical and technical education. On the last-named subject Mr. Huxley speaks with some hesitation, and, while insisting on the importance of scientific training as a preparation for the higher kinds of technical work, maintains that handicrafts can only be learned in the workshop. Medical education, he thinks, needs to be improved in two ways, by excluding some subjects that are commonly included in it and by making the study of the remaining subjects more thorough and profound; and it is somewhat remarkable that one of the studies that he would exclude from the medical curriculum is his own favorite science of comparative anatomy. In treating the subject of education in general, Mr. Huxley, as our readers know, has always been a strong advocate of a more thorough and extensive study of physical science, and his influence in promoting that study has doubtless been considerable; yet he is by no means unmindful of the just claims of other studies. Metaphysics and theology are of course excluded from his curriculum; but he lays stress on the need of logic and psychology as well as of ethics and the social sciences, and he shows a keen appreciation of the "pleasure without alloy" to be derived from the arts of beauty. Several points in his discussion of university education might give occasion for criticism if we had space and time for the purpose, yet with the greater part of his views we cordially agree, and, even where we are obliged to dissent, we generally find his remarks suggestive. Consisting, as the book does, of separate essays prepared at various times during a period of forty years, it lacks the systematic character of a regular treatise; yet it is well worth the attention of all professional educators, and especially of the teachers of physical and medical science.

The Dawn of Astronomy; A Study of the Temple-worship and Mythology of the Ancient Egyptians. By J. Norman Lockyer, F.R.S. New York and London, Macmillan and Co., 1894, 432 p.

This handsome volume, presented on excellent paper, in clear type, and with abundant illustrations, will be considered a valuable addition to the early history and archæology of Egypt and Babylonia, even by those who are unable to accept the author's deductions in many of their details.

He certainly shows by a variety of evidence that most of the earliest architectural monuments were constructed with reference to the positions of heavenly bodies at certain seasons; and therefore that the close observation

and the religious respect of such bodies formed two leading features in ancient science and mythology. In some of the earlier chapters he very properly gives the elements of astronomical knowledge requisite to calculating the position of the stars at fixed periods, and also the methods for determining with accuracy the "orientation" of buildings. This is by no means the same everywhere, and he justly observes that where we find such a contrast as in the temples of Thebes and Memphis, in one of which we find "solstitial" and in the other "equinoctial" orientation, it demands almost a difference of race to explain it.

Professor Lockyer, availing himself of the French and German surveys of the temples of Egypt, aided by studies of his own made on the spot, finds that one of the main objects of the temple of Karnak, for instance, was for the purpose of obtaining an exact observation of the precise time of the solstice; that many of the temples were not intended for solar but for stellar observations; and as these, owing to the change of place of the stars, would not have remained true for more than three hundred years, they furnish us a means of approximating the date of their construction. On this theory, the author calculates one of the temples at Edfu to have been constructed for the observation of the star Canopus, and to have been built about 6400 B. C. This extends the epoch of culture in Egypt far beyond the time usually fixed by modern archæologists, and illustrates the great value of the author's methods, if they should prove acceptable to the scientific world.

Several chapters of the volume are occupied with the astronomy of the early Babylonians. It would seem this was based on independent observations not less ancient than those of Egypt, but at first exerting no influence upon them. Later, at an undetermined but a very remote period, the astronomic science of northern (lower) Egypt was deeply tinged with the stellar and solar doctrines and myths of Mesopotamia.

The volume is full of suggestions for future research, and there is no question but that it puts in the hands of investigators new methods of throwing unexpected light on the origins of civilization. We earnestly hope that not in the Old World only, but in the great ruins of Mexico, Central America and Peru, they will be applied.

Inorganic Chemistry for Beginners. By Sir Henry Roscoe, F.R.S., D.C.L., LL.D., M.P. Assisted by Joseph Lunt, B.Sc. (Vict.), F.C.S. New York and London, Macmillan and Co., 1893, 245 p.

We are always glad to welcome a text-book such as the above, and to mark its improvement over the vast number of elementary text-books in chemistry which have become so common of late. The book is arranged with a proper understanding of a beginner's necessities, and instead of a few paragraphs on chemical theory followed by a dictionary-like description of the chemical elements, we have a proper discussion of the principles, the study of the elements being introduced by a careful analysis of these principles as applied to a few, well chosen, typical examples. It is ridiculous to expect a beginner in any science to grapple at once with its particular symbols and to memorize details which are of no moment. We say of no moment, for without proper introduction these details are meaningless. The laboratory manual has too often been mistaken for a text-book of the science.

We note particularly in the above work the chapters on elements and compounds, combination in definite and multiple proportions, calculations, physical measurements, and the properties of gases. In Part II. the following non-metallic elements are studied with their more important compounds: Oxygen, hydrogen, nitrogen, chlorine, sulphur and carbon.

Principles and Practice of Agricultural Analysis. A manual for the Examination of Soils, Fertilizers and Agricultural Products. By Harvey W. Wiley, Chemist of the United States Department of Agriculture. Easton, Pa., The Chemical Publishing Company. Vol. I., No. 1, 1894.

The first number of this work has been received, and while it may yet be too early to judge of the character of the book as a whole, our expectations are raised, and we shall look for an epoch-making work on agricultural chemistry. Professor Wiley is of all men in this country the most competent to write upon the subject, his long connection as Chief of the Chemical Department of the United States Department of Agriculture and his many writings in scientific journals being sufficient evidence of this. Part first includes an introduction, in which the elements of the earth's "crust" are discussed, particularly in their relation to agriculture, together with the rock-forming minerals and finally the subject of rocks and rock decay. The typographic work is excellent, and the number is well illustrated with sketches and with reproductions of photographs illustrating microscopic rock structure and the physical changes in rocks. It is proposed to issue this work in twenty to twenty-four monthly parts of forty-eight pages each, selling at twenty-five cents a number.

NOTES AND NEWS.

Macmillan & Co.'s announcements of forthcoming books include "The Study of the Biology of Ferns by the Collodion Method," for advanced and collegiate students, by George F. Atkinson, associate professor of cryptogamic botany in Cornell University; "Mental Development in the Child and the Race," by James Mark Baldwin, Stuart professor of experimental psychology in the College of New Jersey, author of "Handbook of Psychology," etc.; "Materials for the Study of Variation in Animals," part i., "Discontinuous Variation," by William Bateson, M. A., Balfour student and fellow of St. John's College, Cambridge, illustrated; "A Three Months' Course of Practical Instruction in Botany," by F. O. Bower, D.Sc., regius professor of botany in the University of Glasgow; abridged edition of "A Course of Practical Instruction in Botany," by the same author; "A History of Mathematics," by Florian Cajori, professor in Colorado College; "A Course in Experimental Psychology," by James McKeen Cattell, A.M., Ph.D., professor of experimental psychology in Columbia College; "The Gypsy Road, a Journey from Krakow to Coblenz," by Professor G. A. J. Cole, M.R.I.A., F.G.S., illustrated; "Elements of Metaphysics," by Professor Karl Deussen, of Kiel, authorized translation; "Life in Ancient Egypt," described by Adolf Erman, translated by H. M. Tirard, with numerous illustrations and maps; "Physiology for Beginners," by Michael Foster, M.A., M.D., LL.D., F.R.S., and L. E. Shore, M.A., M.D., B.C.; "Western Europe in the Fifth Century," lectures delivered at Oxford, by E. A. Freeman, D.C.L., late regius professor of modern history in the University of Oxford; "Western Europe in the Eighth Century," lectures delivered at Oxford by E. A. Freeman, D.C.L.; "The Life of Sir A. C. Ramsay," by Sir Archibald Geikie, F.R.S.; "A Short Manual of Philology for Classical Students," by P. Giles, M.A., fellow of Gonville and Caius College, reader in philology in the University, Cambridge, uniform with Dr. Gow's "Companion to School Classics"; "Town Life in the Fifteenth Century," by Alice Stopford Green, in two volumes, 8vo; "Hydrostatics," by A. G. Greenhill, F.R.S., professor of mathematics to the senior class of artillery officers,

Woolwich; "Logic," by Williston S. Hough, A.M., assistant professor of mental and moral philosophy in the University of Minnesota; "Methods of Histological Research," for the use of students and physicians, by Dr. C. von Kahlden, lecturer in the University of Freiburg, translated by H. Morley Fletcher, M.A., M.B.; "Popular Lectures and Addresses," Vol. II., contributions to geology, by Lord Kelvin, P.R.S. (Sir William Thomson); "Sketches in Sport and Natural History," by the late George Kingsley, M.D.; "Text-book of Embryology: Invertebrates," by Drs. Korscheldt and Heider, privatdocenten, University of Berlin, translated and edited by Edward Laurens Mark, Ph.D., Hersey professor of anatomy, Harvard University, and William McMichael Woodworth, Ph.D., instructor of microscopical anatomy, Harvard University, fully illustrated; "Organic Chemistry," translated by Alexander Smith, professor of chemistry in Wabash College; "Macmillan's School Library," "Town Geology," by Charles Kingsley; "Physiography for Beginners," by J. E. Marr, F.R.S., F.G.S., and Alfred Harker, M.A., F.G.S.; "Pain, Pleasure and Æsthetics," an essay concerning the psychology of pain and pleasure, with special reference to æsthetics, by Henry Rutgers Marshall, M.A.; "A Manual of Laboratory Physics," by Edward L. Nichols, Ph.D., professor of physics, Cornell University; "A Manual of Physical and Chemical Measurements," by Professor Wilhelm Ostwald, translated by Dr. James Walker; "The Theory of Heat," by Thomas Preston, M.A., Trinity College, Dublin, with illustrations; "The Theory of Sound," by Lord Rayleigh, F.R.S., formerly fellow of Trinity College, Cambridge, new edition, in 2 vols., 8vo (in this new edition the whole subject will be included in two volumes); "Modern Plane Geometry," by the Rev. G. Richardson, assistant master at Winchester College, and A. S. Ramsey, Fettes College, Edinburgh; "The Rise and Development of Organic Chemistry," by the late C. Schorlemmer, F.R.S., translated and edited by Professor Smithells, Yorkshire College, Leeds; "Atlas of Classical Antiquities," by Th. Schreiber, edited for English use by Professor W. C. F. Anderson, Firth College, Sheffield; "Systematic Survey of the Organic Matters," by Drs. G. Schultz and P. Julius, translated and edited, with extensive additions, by Arthur G. Green, F.I.C., F.C.S., examiner in coal-tar products to the City and Guilds of London Institute; "Elementary Algebra," by Charles Smith, American edition; "Geometrical Conic Sections, by Charles Smith, M.A., master of Sidney Sussex College, Cambridge; "Oxford and her Colleges," a view from the Radcliffe, by Goldwin Smith, D.C.L., author of "A Trip to England," "The United States: an Outline of Political History—1492–1871," etc., with frontispiece; "Practical Plane Geometry," by J. Humphrey Spanton, gold medallist of the Royal Academy of Arts, London, drawing instructor to the Royal Navy cadets of H.M.S. Britannia; "Elementary Mensuration," with exercises on the mensuration of plane and solid figures, by F. H. Stephens, M.A.; "Essays in Historical Chemistry," by Professor T. E. Thorpe, F.R.S.; "Organic Chemistry for beginners," by G. S. Turpin, M.A. D.Sc.; "Lectures of Human and Animal Psychology," by Wilhelm Wundt, Ph.D., M.D., Dr. Jur., professor of philosophy in the University of Leipzig, author of "Grundzüge der Physiologischen Psychologie," "Ethik," "Logik," "System der Philosophie," etc., editor of the *Philosophische Studien*, translated from the second and revised German edition (1892) by J. E. Creighton, A.B. (Dalhousie), Ph.D. (Cornell), associate professor of modern philosophy in Cornell University; and E. B. Titchener, A.B. (Oxon.), Ph.D. (Leipzig), assistant professor of psychology in Cornell University.

—The French world of science has suffered a severe loss in the recent death of Professor Edmond Fremy, of Paris. Born in 1814, his father a professor at St. Cyr, Fremy began the study of chemistry during a period of great

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activity in that science and by his labors extending to the present day has done much to further its advance. His first publications date from 1835 and include many valuable memoirs, but in this country he is probably best known through his treatise on chemistry in six volumes, and through his magnificent chemical encyclopedia. Probably his most recent work is that published but a short time ago in conjunction with a pupil, M. Verneuil, a treatise on the artificial production of rubies.

—An " Elementary Textbook of Agricultural Botany of the University Extension Series," by M. C. Potter, Professor of Botany in the Durham College of Science, Newcastle-upon-Tyne, has just been published by Methuen and Co., of London. The writer considers it the best botany extant for beginners. Scientific facts are presented in such a clear, forcible and interesting way that the rudiments of botany may be acquired by its use with little effort and without the aid of a teacher. It begins at once with the study of the cell instead of the seed, as is customary in such books. He treats of the seed under the fruit where it belongs and of which it is the essential part. The study of the microscopical parts of plants is too often neglected because of a lack of knowledge of the use of the microscope and technique, without which, however, it is superficial and disjointed. There is a chapter on plant food, another on reproduction, another on grasses, another on the bean family with its bacteroids and another very valuable chapter on the commonest plant diseases. It ends with a brief system of classification. The book is invaluable to young agriculturists, for whom it was especially intended. The writer has introduced it into his beginning classes and finds it excellent.

—The Open Court Publishing Company have issued Professor Ribot's work on " The Diseases of Personality " in their Religion of Science Library. By diseases of personality M. Ribot means such nervous diseases as affect the mind, including not only the various forms of insanity but also the milder kinds of mental disorder, whether affecting the intellect or the emotions; but as the work before us was noticed in *Science* when it appeared in a bound volume some years ago, we need not dwell on the author's views now. The books forming the Religion of Science Library, of which this is the fourth, are published in pamphlet form, with good clear type, at twenty-five cents a number, or $1.50 a year, and will include works both new and old on various subjects in science and philosophy.

—The University Press at Cambridge has undertaken to publish a complete translation of the Pali Jataka or " Buddha Birth-stories," which are supposed to be the oldest collection of folk-lore stories in existence. The first volume is now in the press, and has been prepared by Mr. R. Chalmers, late of Oriel College, Oxford, a former pupil of Prof. Rhys Davids. It will contain the forty stories given in Prof. Rhys Davids's discontinued translation, but will also give the remainder of the first volume of Prof. Fausböll's edition of the Pali text. The second volume is translated by Mr. W. H. D. Rouse, Fellow of Christ's College, and the third by Mr. R. A. Neil, Fellow and assistant-tutor of Pembroke College, and Mr. H. T. Francis, under-librarian of the University Library at Cambridge and late Fellow of Gonville and Caius College. The whole translation will appear under the editorship of Prof. Cowell, of Cambridge. The work is expected to fill seven or eight volumes ; but at present only five volumes of the Pali text have appeard. Each volume of the text is to be represented by a volume of the translation. This Buddhist collection of stories will be of great interest and importance for students of folk-lore ; and it will also be of value as illustrating the manners and customs of ancient India. The stories are generally told in a simple popular style, with not infrequent touches of quaint humor and pathos ; and they give us a moving panorama of Hindu society in the immediate centuries before our era.

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CONTENTS.

SOME RECENT WORK ON CLAYS. G. Perry Grimsley . . . 99
A PLEA FOR THE STUDY OF THE PHILOSOPHY OF MATHEMATICS. Franklin A. Becher . . . 100
THE LOCO-WEED. W. Thornton Parker, M.D. . 101
NOTES ON GEOMYS BURSARIUS, THE POCKET-GOPHER Henry Leslie Osborn, Ph.D. 102
AN IMPEACHMENT OF "SCHOOL BOTANY." George H. Hudson 103
CURRENT NOTES ON ANTHROPOLOGY.—No. XL. Edited by D. G. Brinton 105
EARTHQUAKES IN AUSTRALASIA.—III. George Hogben, M.A. 106
LETTERS TO THE EDITOR:
VOLCANIC ROCKS IN THE KEEWATIN. Alfred R. C. Selwyn 107
INQUIRY REGARDING FRESH-WATER PEARL FISHERIES. George F. Kunz 108
PSEUDO-AURORA. H. L. Bolley 108
NOTES AND QUERIES. H. F. Bassett . . . 108
CHILOPODA MIGRATING IN BROAD DAY-LIGHT. F. C. Kenyon 109
A MINIATURE WATER LILY. H. B. Ayres . . 109
CORN—A QUERY. E. M. Danglade . . . 109
ROPE OF MAGGOTS. F. M. Webster . . . 109
BOOK-REVIEWS 109

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From all this, which is a part of our current knowledge, it appears that the problem of protection from lightning is a problem in the dissipation of energy; that the energy to be dissipated, while we know it to be considerable, as broken masonry testifies, is but a small part of the whole involved in a flash of lightning, by far the larger part being dissipated as heat above the roofs of our houses. If the conditions can be so arranged, by the use of considerable masses of metal suitably placed, that there shall be no state of stress below the roof of the house, then there will be no energy to be dissipated below that level, and all will go well. But it is surely time that the problem of protecting buildings from lightning should be looked upon as one in energetics and that it should be appreciated that the energy present cannot be hocus-pocussed out of the way but must be dissipated in some harmless manner.

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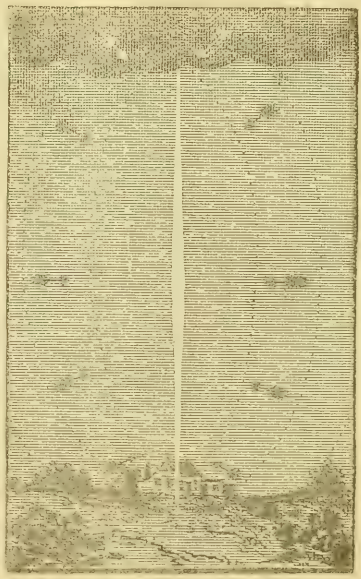

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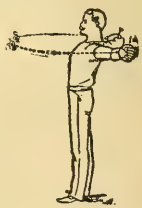

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SCIENCE

NEW YORK, FEBRUARY 23, 1894.

SOME RECENT WORK ON CLAYS.[1]

BY G. PERRY GRIMSLEY, BALTIMORE, MD.

THE seventh volume of the Ohio Geological Survey, under the direction of Prof. Edw. Orton, which has just appeared, contains an extended and interesting chapter on the clay deposits and workings in that State. The work is primarily intended for the assistance of those actively engaged in this work, and many suggestions are given which will prove of great value; but here also will be found the only complete account of the process of manufacture of city paving materials.

Ten years have passed since the last published work on Ohio clays; in this interval there has been great expansion in the industry, and new features have been introduced. At the present time there are over twenty-five distinct lines of clay manufacture, and in most Ohio leads. In the sewer-pipe industry it stands foremost in amount of ware and in possession of three of the largest factories in the world.

Coal has always been regarded as Ohio's great source of mineral wealth, but where this is removed clay deposits are found which are greater sources of wealth than the original coal. Thus the Ohio coal measures are now becoming the clay measures.

The best clay must be free from calcium, iron and alkali bases, for if these be present they will act as fluxes, so destroying the clay as a refractory material. Since clay originates from minerals containing these elements, it is rare to find this high grade clay, and, when found, the deposits are most valuable.

There is no true scientific classification of clays, but they are popularly divided into clays and shales; the latter originated in deeper water and very often show no plasticity. A high grade clay is composed of kaolin and silica, while the poorer grades in addition have the fluxing elements.

It is found that nearly every coal seam is underlaid by a clay, locally called fire clay. In most cases it is everything but a fire clay and is used only in potteries.

Most of the true fire clays of Ohio belong to the non-plastic type. In this clay small microscopic bundles of rods are found, indicating incipient crystallization; it is thought the peculiar property of hard fire clay depends on this property, since there is no chemical difference between such a clay and a plastic one.

The lowest clays worked in the State are found at the base of the Upper Silurian, but they are only of local interest. The first important series to be worked is the great mass of Devonian black and blue shales at Columbus used in the extensive sewer pipe industry. The best clay in quality is found in the sub-Carboniferous Sciotoville clay used for fire brick.

The important clay industries of the State are based almost wholly on the coal measure clays and shales. Under and over the coal occur clay and shales.

The first of the Ohio coals has a roof of shales, which forms the basis of one of the largest sewer-pipe and roofing tile works in this country, located at Akron.

The Mercer clays, below the Mercer coals, are used in the manufacture of terra cotta and ornamental brick, while the Kittanning series support a second fire brick industry at Mineral Point.

In the Freeport horizon occur the clays and shales which are used so extensively in central Ohio for the manufacture of paving brick.

It would be interesting to follow out the development in the different lines, if space permitted, but only the new enterprise introduced in the last few years into this country will be reviewed. This whole subject has been most carefully investigated and described by Mr. Edw. Orton, jr., in this report.

Ten years ago shales were regarded as so much waste in the clay workings; now they are found to be of great value.

The difference between paving brick and common brick rests on the fact that the elements of the former have reached a state of fusion, and so are chemically united; while in the latter it is more the physical union of adhesion. The true test is absorption, which would be nothing in a perfect paving brick.

The clay must conform to certain conditions in order to yield a good paving brick. It must combine refractoriness with fusibility and must be sufficiently plastic to be easily worked. The amount of iron present determines the color of the ware and smoothness of surface.

An average of a large number of analyses shows the composition of a good paving brick to be 84.78 per cent clay and sand, 13.22 per cent fluxes. High heat is not required and if present ruins the product.

These shales have lost their natural plasticity, which must be regained. This is accomplished by grinding the dry material to a powder and tempering this to the proper consistency by the use of water.

The universal method of grinding in Ohio is by the use of a large revolving pan, with two heavy iron wheels moving in this. The clay is next carefully screened to varying fineness, usually the finer the clay the finer and more durable the brick.

The value of the ware depends most of all on the *tempering;* this is accomplished at the least cost by means of

[1] Geological Survey of Ohio, vol. vii., part i. Columbus, Ohio, 1893.

the well-known pug mill. By the use of this machine the mixture is rendered very uniform.

Of all the methods used for making the bricks, the best seems to be that of moulding the clay when in stiff condition. The clays in the stiff mud machines are tempered to a plastic state; when freshly made these bricks will retain their shape under considerable weight.

The machine most generally used is the Auzer machine, consisting of a revolving screw which carries the clay forward and forces it out of the die. It combines economy of handling with a saving of steam power. The great objection is a tendency of the machine to build the bar of clay out of concentric layers, especially in a very plastic clay. By the use of shales, this difficulty has been partially removed.

Automatic cut-off tables have been devised which dispense with the slow method of hand cutting. In a recent test 250 bricks per minute were cut and removed.

Re-pressing the bricks, which was once in great favor, is found to add nothing to their value, though the method is still used.

The bricks must be carefully dried to rid them of the large amount of water used in mixing the clays. They must finally be burned so as to possess the qualities of toughness, vitrification, and uniformity.

The cost of manufacture, including loss in burning, averages about seven dollars per thousand. The cost to cities averages fourteen dollars, which will probably be greatly reduced under better financial management.

There are at present in Ohio forty-four manufactories, with 357 kilns, making annually 292,000,000 bricks.

A PLEA FOR THE STUDY OF THE PHILOSOPHY OF MATHEMATICS.

BY FRANKLIN A. BECHER, MILWAUKEE, WIS.

In early times mathematics and philosophy were kindred sciences. Mathematics was the essential study required to a preparatory entrance into the higher and more advanced branches of human knowledge. They were the complements of one another. Both set out with definite ends in view, yet the methods pursued were in some respects quite different. While the one assumed certain postulates to be true for the purpose of developing the science, the other was endeavoring to establish a principle upon which everything extant rested. The methods pursued were almost diametrically opposite. Mathematics developed in the direction from the particular to the general. It was not until the introduction of the idea of the function, by Euler, into mathematical reasoning that a more general method was possible. A philosophy of any science cannot be established until some well-defined general conceptions are developed. The philosophy of mathematics is no exception to this rule. Through the development of a more general method, the conceptions extended and became more universal; that which gave impetus to this was the introduction of the idea of the function. It was not long before the method of inquiry changed in this respect. Formerly higher algebra sought mainly to determine those values of functions for which they vanished, while modern algebra has for its problem to discover the peculiarity or nature of the function, regarding only incidentally the numeric value. The masters of modern higher algebra have gained thereby an opportunity to discover new thought-forms, which differ essentially from the old ones. These new thought-forms have aided much in suggesting many beautiful theorems and problems which again have led up to new discoveries. The progress made has been with giant strides, so that many fundamental conceptions and propositions are fast losing their validity. It is but within recent times that the conception manifoldness was introduced into mathematical reasoning by Riemann. This conception sheds light over the whole field of mathematics, and therefore has aided in establishing a foundation for a philosophy of mathematics. The essentials to a philosophy of the science are well stated by Grassmann, who says: "Since both mathematics and philosophy are sciences in the strictest sense of the terms, the methods employed in each must accordingly have something in common, which gives them their peculiar scientific character. Now, we give a scientific character to a method of treatment when the student, on the one hand, is of necessity led by it to the recognition of every single truth, and on the other hand is placed in a position wherefrom he is enabled, at every point in the development, to survey the course of further progress." Here we have the importance shown of having some central conception or conceptions, from which we can view the whole field. The men and their works that have contributed to establishing these general methods and conceptions, thereby laying a foundation for a philosophy of mathematics, are: Grassmann, in his "Ausdehnungslehre" (Hyde's Directional Calculus); Hamilton, in his "Quarternions"; Pierce, in his "Linear Associative Algebra," and Cantor, in his "Mannigfaltigkeitsrechung," the most important work from a philosophical standpoint.

Few, if any, of our universities seem to devote any time to the study of the philosophy of mathematics, and there are only a small number that embody any of the above named subjects in their curricula. In fact, it is only very recently that our modern text-book writers have deviated from the trodden path and introduced some of the more advanced notions in their works. It is only within a few months that a new and excellent treatise, the first in this country, on the "Theory of Functions," by Harkness and Morley, has appeared. Why most of our mathematical text-book writers, like lawyers, have a strong inclination to adhere to old musty forms and ways of presentation is difficult to perceive.

The importance of the study of the philosophy of mathematics is beyond all question. A knowledge merely of the objective side of any subject is not only detrimental to its presentation, but a thorough knowledge of the subject can never be obtained. It is like the bones and muscles to the human body without the nerves. Again, if these subjects are not taught which lead up to the philosophy of mathematics, so that a consistent, true and proper view can be had of the entire field of this knowledge, a teaching of this branch is fruitless. The study of all the fundamental principles of these subjects and the study of the philosophy of mathematics ought to be thoroughly mastered by every one who aspires to have an accurate knowledge of the subject and wishes to become a mathematician.

—J. B. Lippincott Company announce as an addition to their extensive list of medical books a new volume entitled "Pain," by J. Leonard Corning, A.M., M.D. The author has made a specialty of the study of this important subject, and holds that there is no department of neurology a knowledge of which is so essential to the physician.

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THE LOCO-WEED.

BY W. THORNTON PARKER, M.D., GROVELAND, MASS.

THE locoplant is regarded by Professor Gray, of Harvard University, as the *Astragalus legum*, a peculiar species of the vetch tribe, abundant in the region of the "Texan Panhandle," and agreeable to cattle and horses, but, after having been used for some time by the latter, causing a special madness; hence its name, from the Spanish "loco." As a food its use renders horses valueless, and these seem to suffer most from this plant. It seems to have for them the fatal attraction that opium has for too many human beings. It has not yet been proved that cattle suffer very much, if at all, from this poisonous plant. Dr. J. W. Carhart, in a communication to the *New York Medical Record* concerning the symptoms and etiology of this curious affection, states that "The prominent symptoms seem to be due in part to a loss of muscular co-ordination; the horses become weak and staggering, and a slight blow on the head of an affected animal causes him to rear and fall over backwards. The animal falls away in flesh, and its coat loses its shining appearance, the hair becoming rough and of a dirty color. The brain as well as the spinal-cord would seem in certain cases to be affected, as it is stated that the animals often become absolutely crazy." The symptoms of the disease, as I have described them in a contribution to the same medical journal, agree perfectly with this description of Dr. Carhart's.

While serving in the Medical Department of the United States Army in Texas and New Mexico, I had ample opportunity to witness the poisonous effects of this plant on horses. I procured many excellent specimens, without any difficulty, and sent them to the Smithsonian and other institutions in this country and Europe. The weed does not grow as high as has been stated; it rather clings to the ground, resting upon it like a flat green mat, about the size of a small plate. Even in winter, when the grass all about is shrivelled and brown, this plant presents a bright velvety appearance, readily attracting the attention of horses and other animals, who eagerly devour it. It is very important that some investigation should be instituted, with a view of inaugurating a successful treatment for this disease. Anyone who has witnessed the actions of a locoed horse must have arrived at two conclusions; first that human beings are on account of its peculiar manifestations exposed to great bodily danger; a locoed horse without any warning starting over dangerous places or into deep water—in other words, without warning becoming unmanageable. The other conclusion is that a disease whose cause and symptoms are so obvious and well known ought to be amenable to treatment. My own observations and experiments have convinced me that the use of the muriat tincture of iron, and in fact one or two other drugs, with the accessories of hygienic treatment, will, if taken in time, act favorably upon the animals affected. "In view of the evident importance to the economical interests of that portion of the country," I think that the Government should make the necessary experiments. Referring again to my article in the *New York Medical Record*, "The symptoms of the disease, as well as the description of the plant which is the apparent cause of them, recalls the accounts given by various French and Italian writers of lathyrism. This affection presents the symptoms of a spastic paralysis of the lower extremities, the individuals having a remarkably ataxic gait. The sensibility of the skin of the lower extremities is greatly increased; there is exaggerated patellar tendon reflex, and the ankle clonus is excited by the slightest movement of flexion of the foot. The plant, to the poisonous effects of which lathyrism is attributed, is also a species of vetch, the *Lathyrus cicera*. The disease attacks chiefly men, but horses have also been known to be affected. Vision seems to be disturbed in grass staggers, but in lathyrism the eyes are unaffected. The poisonous principle of the lathyrus has not been isolated, but experiments upon animals would seem to show that it resides in the healthy plant, and not in a mildew."

Lathyrism appears to be a curable disease. It sometimes subsides spontaneously when care is taken to exclude the vetch from the diet of the patient, and its disappearance may be hastened by the administration of bromide of potassium in large doses. Revulsive applications to the spine are said also to be beneficial. Possibly a similar plan of treatment for "locoed" ponies might be followed by good results, although there would be some difficulty in weaning them from their fondness for the poisonous weed.

—At the meeting of the Chemical Society of Washington on Jan. 11, 1894, the following officers were elected: President, Dr. W. H. Seaman; Vice-Presidents, Mr. A. E. Knorr and Professor Charles E. Munroe; Treasurer, Dr. E. A. deSchweinitz; Secretary, Dr. A. C. Peale; additional members of Executive Committee, Dr. H. W. Wiley, Professor F. W. Clarke, Professor R. B. Warder and Mr. F. P. Dewey. The following papers were read: "On a Supposed Synthetic Sucrose, with Description of Process of Making," by Dr. W. D. Bigelow, and "The Differentiation of Fats," with illustrations by Dr. Thomas Taylor. The meeting of Feb. 8 was devoted to the annual address of the retiring President, Mr. F. P. Dewey, on "The Aluminium Age."

—Those who have read Dr. Charles C. Abbott's "Recent Rambles" will need no urging to take up his "Travels in a Tree-Top," shortly to appear from the Lippincott press. Whether he tells us of what he finds in the top of a tremendous oak, or of what he sees from his high perch among the leaves; whether he narrates amusing stories about corn-stalk fiddles and a Quaker grandfather, or the kitchen door of his old home in boyhood times; whether he describes for us a dinner among the Indians before Columbus "arrived," or reminds us how the bees and buckwheat of August develop into honey and buckwheat cakes for these cool mornings—he is equally genial and charming. The volume is to be printed on fine paper and in outward appearance will be both rich and dainty.

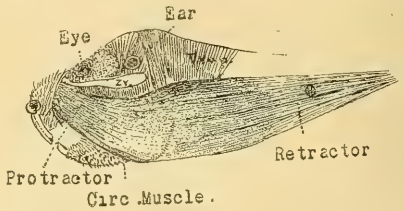
NOTES ON *GEOMYS BURSARIUS*, THE POCKET-GOPHER.

BY HENRY LESLIE OSBORN, PH.D., ST. PAUL, MINNESOTA.

PENDING the publication of a fuller account of this interesting creature, it seems to be worth while to call the attention of students of the subject to some of the more interesting points already determined. The animal is well known in the northwestern United States, where in some regions, its habits protecting it from capture, it becomes a very great pest. In the vicinity of St. Paul, Minn., its traces are to be seen in open fields, where it can be recognized by the mounds of finely grained dirt that mark its excavating operations. It is very shy and largely nocturnal, but in more sparsely settled places it is seen in the day-time. I have never seen it in the fields that are near my home, but its mounds are common about here everywhere. The fossorial habit is thus less positive and exclusive than in the mole and in the mole-rat of Europe. Yet this animal is truly subterranean, and its structure in many interesting ways is a departure from that of ordinary rodents. In its work of digging it goes into its burrow head foremost, using the head and fore limbs nearly equally. The dirt as it is loosened is first kicked under the animal till it is collected in a mass, when the creature turns about and with the fore limbs pushes it up out of the way. The animal is thus an important agent in this vicinity in that work of the circulation of the ingredients of the soil that Darwin showed us is one of the important parts played by earth-worms in the world economy.

THE POCKETS.—The anterior part of the head of the pocket gopher is unusually elongate for a myomorph, so that the incisors are pushed out a long way in front of the molar region. This anterior region is, by reason of the great compression of the palatal region and the consequent narrowing of the roof of the mouth, well adapted for the ingrowth of the hairy portion of the upper lip, so that the latter surrounds the upper incisors, reducing the palatal area to a very narrow groove in the centre of the roof of this part of the mouth chamber. The entire roof of the mouth is covered with hair and is closed behind at the level of the molar teeth by a constriction that leaves only a circular opening at the rear closed by the short tongue. This anterior portion of the mouth may be called the vestibule, as it leads also to the pockets. It is really more external than internal, and this character is of importance in the use of the mouth as an organ of excavation. The pockets are apparently the homologue of the cheeks. They are bounded by a fold of skin on the outer side which arises from the maxillary region of the face and runs downward to the lower jaw some distance behind the bases of the lower incisor teeth.[1] Inside this fold of skin the pockets run backward to the level of the hinder border of the scapula. The pockets thus situated are lined internally with the softest hair and like the vestibule already noted are really external cavities and not a part of the mouth. The indications from a study of the pockets in other rodents, as well as from the anatomy of Geomys, are that the pockets, though thus external, are the homologues of the cheek cavities and that the clothing of hair is a secondary character.

The muscular structure of the pockets is interesting. The muscles are presumably part of the paniculus carnosus, though they are directly attached to the bony skeleton specialized for their peculiar functions. There are three distinct sets of muscles present; these are, first, a circular muscle that runs around the margin of the pocket in its outer bounding fold. This by its contraction would seem to purse the opening of the pocket. The second set of muscles are those that I will call the protractors of the pockets. These are two in number on each side. They are spread out in the skin of both the inner and outer posterior portions of the pockets, and their fibres converge forward to finally form somewhat definite bands. The outer of these is attached in the skin at the origin of the fold on the upper jaw. The other is attached to the lower attachment of the fold at the lower jaw. These two muscles thus surround the pocket, and their contraction pulls its recess forward to the opening of the vestibule. The third set of muscles are the retractors of the pocket. These arise funnel-wise from surface of the pocket both on its inner and outer aspects, and they run backward and dorsally parallel to the fibres of the latissimus dorsi and totally free from the skin. They form a band three or four inches long and nearly an inch wide and are finally inserted in the tendinous aponeurosis that covers the in-



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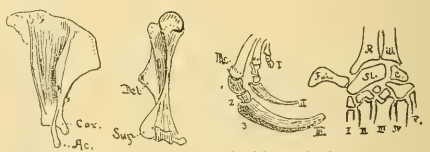
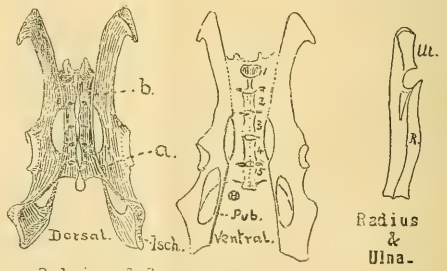


Scapula Humerus Middle-digit Carpus



Pelvis of Geomys. Radius & Ulna.

sertion of the latissimus dorsi and is attached to the neural spines of the anterior lumbar vertebræ. These by their action retract the pockets. As to the use of the pockets, it has been erroneously thought in general among the people where the gopher is common that its pockets are used in the removal of dirt. Not a single well ascertained fact can be cited in proof of this notion, and it has been certainly ascertained that the pockets are used for the reception of the harder portions of the food which are removed in them to be stored away for winter use. The softer parts of the food are eaten and digested at the time.

THE VERTEBRAL COLUMN.—The cervical vertebræ, seven in number, are rather small, and in this way it results that

[1] See Baird, U.S.P.R.R., vol. viii., pl. cxi.

the neck region is short and the head brought nearer the shoulders. This diminution of the size of these vertebræ is not confined to any one, but is shared by them all. The second, however, has a very large neural spine. The seventh cervical vertebra is peculiar in being closely related to the first dorsal by its transverse processes, and the tubercle of the first rib articulates nearly equally with this cervical and with the first dorsal. The first rib is unusually stout, and its head is somewhat enlarged. The vertebræ of the back and loins do not call for special comment; there are twelve dorsal and seven lumbar vertebræ. It is perhaps worth while to note in passing that the lumbar vertebræ do not present any of those strong processes so noticeable in many of the rodents (as for example Lepus), but they are small and compact. The sacrals are, however, very exceptional in their character. There are five vertebræ in the sacrum. These are immovably anchylosed by their transverse processes into one piece. Their neural spines are widened and thickened at the summits so as to form a longitudinal ridge with only small openings between the spines. In the same way the laminæ of the arches are broadened and flattened to form an area sharply ridged on the margin and which posteriorly meets and anchyloses with a growth from the ischium in a manner somewhat recalling the pelvis of a bird. A somewhat similar condition is to be found in the pelvi of the two-toed sloth, *Chelopus hofmanii*. The first and second sacral vertebræ are immovably grown to the iliac bones by a surface that extends over the entire inner side of the ilium of each side, and the third sacral vertebra joins partially in the formation of this articulation. The fourth is free laterally, as is the hinder part of the third, but these are completely grown to their neighbors, both before and behind. There are seventeen caudals. These are short and stout, and the anterior ones are supplied with strong processes for the attachment of strong muscles.

The Anterior Limb.—A stout clavicle is present. The scapula is short and broad, its coracoid portion is drawn out into an unusually long process. The spine of the scapula is very high, and the acromial process is greatly elongate and drawn out beyond the level of the glenoid cavity. (Cf. Bathyergus.) An additional strong ridge traverses the posterior border of the scapula, to which the immense triceps is attached. The humerus is short and stout, its deltoid ridge is very strong and angular, the distal end is very broad and drawn out on either side into huge areas for muscular attachment. There is no entepicondylar foramen (though one is often present in rodents)[2]. The radius and ulna are short and strongly compressed and furnished with sharp angular ridges that traverse their length. The olecranon process of the ulna is very long and strong, as is to be expected from the huge triceps already referred to. A long curving bone, "falciform," is articulated to the radial side of the wrist in addition to the pisiform bone. This is the supporting piece for the great callosity of the wrist. The metacarpals are not of equal size, the first and second being smaller and the middle one being the largest. The first row of phalanges is short, and the second row is reduced almost to a merest rudiment; the distal, ungual, phalanges, however, are large, and the middle one is largest of all. This is with reference to the production of the immense nail, which is the chief one used in the act of digging. This reduction of the proximal phalanges so as to allow a more direct pull on the terminal digit, where the chief resistance comes, is paralleled in the structures of the fore limb of cetaceans, for instance. The reduction of the neck in the gopher is also a similar case.

The Posterior Limb.—The pelvic bone has already been partly described in speaking of the sacrum. It is so peculiar that it will require a somewhat detailed description. The accompanying drawings will help to make the matter clearer. The iliac portion of this bone is divided on its ectal surface by a very strong ridge into two parts, above and below the ridge, respectively. This ridge, furthermore, terminates anteriorly in a hook-shaped process which projects obliquely outward and backward. The ischial portion of the pelvis is drawn out into three strong processes, the most anterior of which is, as already stated, anchylosed firmly to the sides of the fifth sacral vertebra. The pubic portion of the pelvis is reduced to a narrow and very slight bone, which, instead of running inward to meet its mate and form a pubic arch, as is general in the mammalia, runs parallel or divergingly, according to the sex of the specimen. In the female there is no symphysis pubis, the two sides being widely divergent, as in birds. In the male the pelvis is much like that of the female, but there is a narrow bridge of bone across the interval between the widely parted parallel pubic bones. The appearance of this leads one to regard it rather as an ossification in tendon than any portion of the pubic bone. I have not as yet, however, had the good fortune to see any embryonic material and have no proof to offer on the homology of this structure.

The femur is not nearly so stout as the humerus. The tibia and fibula are anchylosed, as is usual in Myomorphs. The fibula is very slender. The hinder foot is small and not peculiar, the work of digging being apparently confined wholly to the anterior limb.

[2] The statement occurs in Flower and Lyddeker's "The Mammalia Living and Extinct," p. 446, as well as in the article "Mammalia," in "The Ency. Brittanica," from which the former is largely a reprint, that "in all existing forms of rodents the humerus has no entepicondylar foramen." This statement is perhaps true in general, but there are a number of cases where the foramen is normally present. I do not know of any Hystricomorphs in which the foramen is present, and it is not present in the Leporidæ, but in many of the Suromorphs and Myomorphs it is present. I have observed it in the following genera: Sciuropterus, Spermophilus, Cynomomus, Haplodon; and it is absent in Sciuras Tamias, Castor; it is present in the Myomorphs, Hesperomys, Onychomys, Zapus, Dipodomys, Cricetus, and absent in many closely allied forms, such as Mus, Fiber, Myodes, Cuniculus, Geomys, Gerbillus, Georychus, Alactaga.

AN IMPEACHMENT OF "SCHOOL BOTANY."

BY GEORGE H. HUDSON, VICE-PRINCIPAL STATE NORMAL AND TRAINING SCHOOL, PLATTSBURGH, N. Y.

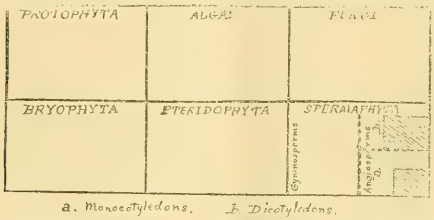
I am in hearty sympathy with the protest in *Science* for Oct. 20, 1893, entitled "A Mistake in Teaching Botany," and for that reason cannot let the communication under the same title in *Science* of Dec. 8 pass without criticism.

To avoid confusion I wish it to be distinctly understood that the following remarks are made with reference to botany in the high school and not in the kindergarten nor in the elementary schools. Bearing this in mind, let us first take the statement of the critic, on page 318, that "There was, some years ago, a disposition to begin the study of a science at the bottom and work upward, . . . But a few years' test showed the many disadvantages of this method, and the opposite, or older, plan has been readopted." This statement is, to say the least, unfortunately expressed. I have yet to see an arithmetic that begins with cube root and works *downward* to notation and numeration, and I have yet to meet a teacher of this, the oldest of our sciences, who advocates such a course because the opposite "savors of book arithmetic." I know of neither text book nor teacher who would take a high school class in United States history, begin with the Hawaiian affair and reverse the order of events until he had traced backwards the discovery voyage of Columbus and left him petitioning for vessels to enable him to reach the East Indian Archipelago by sailing out into the unknown west; and I know of no reason why a "natural history" of the rise, progress, and condition of animal or vegetable life should take a similar course.

An interesting lesson may be drawn from the com-

parison of an old with a new text book of zoölogy. Take, for instance, Tenney's "Manual of Zoölogy," 1871, and Schiedt's "Principles of Zoölogy," 1892. Of Tenney's 535 pages of text, beginning with man, 360 are devoted to the vertebrata, and a footnote on page 533 disposes of the porifera and protozoa. In Schiedt's work of 298 pages of text the first 70 are devoted to the protozoa, and and the last 13 are all that are allowed the vertebrata. Not only do our recent text books in zoölogy follow the new order, but in all we shall find relatively more space given to the heretofore neglected lower branches of the animal kingdom.

This takes us to the matter of the representation of the field which botany should cover, and here we shall find that our "school botany" has remained so far behind the real growing science of botany as to forfeit even the right to use its title. In the vegetable kingdom, as well as in the animal, science has come to recognize a number of large and important elementary branches. Let the following diagram represent the botanical field,[1] and, remembering what school zoölogy is doing for its separate branches, note the small portion of this large field which is presented to students who imagine that they are acquiring a fair representation of the vegetal kingdom as it exists to-day:



The shaded portions of the field show that part which is thus falsely made to represent the whole. Five great branches ignored, one of the two divisions of the last branch barely mentioned, but 2 out of 7 orders of monocotyledons and about 17 out of 30 orders of dicotyledons represented, and this bit of one-sided patch-work called botany. Ten weeks spent in the study of the external structure and the analysis of fifty or more native butterflies, with the aid of French's "Butterflies of the Eastern United States," would furnish work of precisely the same value in every respect as the work usually done in school botany, but the instructor would in all probability be modest enough to call the study entomology.

The weakness of school botany by no means ends here, however. Examine the matter of classification. Groups of species are in a small part recognized, as are also groups of genera, but the relationships between families are utterly ignored. The higher groups are used as if for the express purpose of perpetuating ancient errors. The gymnosperms are still sandwiched between the allied monocotyledons and dicotyledons, and in a similar manner the choripetalæ are rudely and unnaturally split into the polypetalous and apetalous divisions and the gamopetalæ thrust in between them, the more perfectly to hide their natural relationships. Note the false position still held by the ranunculaceæ, though rightfully belonging to the compositæ, and note also the many instances in which a terminology abandoned by science is most seduously preserved.

Small as is the portion presented, and weak as is the taxonomy, still weaker is the outline and coloring with which even that small portion is presented. Here, again, we may draw an interesting lesson through another comparison of zoölogical text books. While in the older works the matter of classification is made of paramount importance, and fills the greater part of the volume, in the new English university extension manual, Thompson's "Study of Animal Life," but 63 out of 369 pages are used for this purpose, the rest being devoted to the presentation of the manifold aspects under which we may view and study the animal kingdom. This book represents the *science* of the nineteenth century. How is it with our school botany? Plant anatomy is represented by merely external features. Of plant physiology, morphology, embryology, phylogeny, geographical distribution, relation to insects, birds, mammals, man, etc., nothing is said. How fascinating is the botany of which Grant Allen gives us such charming glimpses in his "Vignettes from Nature," "Evolutionist at Large," and other sketches; how cold and repellent this usurper. Examine the average course in botany to-day and you could easily imagine yourself back in the time of Linnæus. As if Goëthe, Sprengel, Brown, von Mohl and a host of other workers were yet unborn and Charles Darwin a coming event for which the world is waiting.

Meagre and pitiable as may appear this object, which masquerades as botany, it is by no means yet seen in its nakedness. In some schools, and these by no means few in number, we shall find that "botany" has been reduced to a mere language study through which the meanings of such terms as alternate, terminal, fibrous, linear, oblong, elliptical, ovate, orbicular, obtuse, truncate, and a host of others, are learned. Gray's Lessons are studied in the winter without specimens, and the technical terms committed to memory in spite of the warning of the author himself, who says in the preface (1887), "No effort should be made to commit technical terms to memory. Any term used in describing a plant or explaining its structure can be looked up when it is wanted, and that should suffice."

The matter is really more serious than one would at first suppose. There are, it is true, certain indications which lead us to anticipate improvement. Good text books are beginning to appear. We have those of Bessey, Campbell and Spalding, which show a marked advance in the right direction; but so great is the gulf between these real text books and the limited manuals of a sectional flora, like those of Wood and Gray, that the Regents of the State of New York, basing their questions, as they do, on these manuals, practically prohibit the use of the better text books. It is true that in some places good work, of the character of that in Newell's "Outlines of Lessons in Botany," is being accomplished; and in some schools a bit of real botany is smuggled in through the use of Newell's "Botany Readers," or Hale's "Little Flower People"; but the day is ripe for a general forward movement all along the line.

It is high time that all school teachers, those studying to become teachers, and the children in our high schools as well, knew something of the bacteria, and of millions of human beings murdered through the ignorant distribution of septic germs. Botany may be made to speak with no uncertain sound concerning the gospel of cleanliness. The compound microscope, to those who have used it, is known to be no obstacle in the way. It is high time that we gave our farmers-to-be a chance in the high school to learn something of the rusts, smuts and mildews which in some years cause the farmers of America to lose as high as a billion dollars' worth of food stuffs. There is an eminently practical side to the question, a side that is too frequently ignored.

I impeach our school botany for lack of logical order in presentation, for giving a disjointed and distorted

[1] The form more properly should have represented seven distinct branches, but for the purpose used this more common arrangement is all-sufficient.

view of the field to be covered, for using an unnatural and antiquated classification and terminology, for ignoring the fields of greatest interest which have been so wonderfully developed during the present century, and for degrading true botany to the position of a mere language study. And I also impeach the men of our nation whose intelligence and special knowledge should make them fit judges in this matter for allowing such a state of affairs to exist without the most vigorous and continued protest, and for allowing a study of such practical value and one which might be made "not inferior as a logical praxis to the study of elementary geometry"[2] to secure but a paltry ten weeks' time for its study even in a large majority of the normal schools of this State.

Let us hear from others on this subject. It is indeed time that the biologists of America awoke to the needs of the situation and did something for the pathognomonic condition of this long neglected patient. It is high time to take school botany out of the ruts of a dead past and place it where it may reflect the living science.

CURRENT NOTES ON ANTHROPOLOGY. NO. XL.

(*Edited by D. G. Brinton, M.D., LL. D., D. Sc.*)

NEW FACTS IN AFRICAN ETHNOGRAPHY.

In 1891 Dybowski was sent by the French Government into the eastern part of French Congo to punish a tribe for the murder of the traveller Crampel. He ascended to the Oubanghi, crossed an elevated plateau, and reached the head waters of streams flowing into Lake Tschad. Approaching this plateau, at about 5° north latitude, he found the dividing limit between the Bantu peoples of the south, and the tribes of the Sudan. The last tribe of the Bantu were the Bondjo, the first of the Sudanese were the Bandziri, a branch of the Niam-niam.

The contrast between these was strangely sharp. The Bondjo are extremely savage, slave dealers, and cannibals by taste, slaves being fattened for killing and their flesh sold in the open market. Nor is it dear, as one can buy a slave in good condition for the dining table for about three dollars. The Bondjo have a hideous appearance, owing to their prognathism and their custom of extracting the front teeth.

The Bandziri, on the other hand, are mild in manners, hospitable to travellers, their color a copper brown, large framed, with thin lips and good features. They are not cannibals, and live sedentary and agricultural lives.

An epitome of the results of Dybowski's journey appeared in a recent number of *Le Naturaliste*, Paris, from which these facts are taken.

THE FAR ASIATICS.

The recent work of Mr. Savage Landor on the Ainu of the northern Japanese Archipelago is exciting a certain amount of attention by the vividness of his descriptions and his ability as an artist. It is doubtful, however, if the latter faculty does not at times carry him too far. An ethnologist of repute, who has travelled among these people, writes that he never saw such hairy specimens as Landor depicts; and certainly they are exaggerated types of what the best authorities have reported.

Mr. Landor has a new theory of the aborigines of the islands in question. He believes that the Ainu, coming from the north, conquered and dispossesed an older race, the Koro-pok-kuru, who were akin to the Eskimos, and had come to Yezo from the Aleutian Islands. It is something in the way of this that the western islands of the Aleutian archipelago were uninhabited when discovered, and showed no trace of a previous population.

In this general territory, Professor Schlegel, of Leyden, continues his labor of identifying the tribes mentioned in the Chinese annals. (See *Science*, Sept. 9, 1892, and Dec. 22, 1893.) He suggests that "the people with black teeth," and those "with black legs" are the Tunguse of the lower Amoor River, who wear black seal skin boots reaching to the body. The "Land of Green Hills," where the foxes have nine tails, he thinks is Corea. A black people, north of the Ainu, referred to as "the wide-awake people," he considers to have been some branch of the Tunguse, darkened by exposure and dirt.

THE ZOREISCH INDIANS OF CALIFORNIA.

An interesting article, likely to escape the notice of American ethnologists, has been recently published on the above tribe in the publication office of the Anthropological Society of Vienna. It includes the observations of Baron von Loeffelholtz made in 1857, with additions of a later date by his son. Taken together, they present a vivid picture of the tribe, which at that date lived on Trinidad Bay, California, about 250 miles north of San Francisco, and was still in a highly primitive condition. For instance, not only were bows and arrows the usual weapons, but the arrow-heads were still manufactured of stone, the method of doing which is minutely described. The tribe was peaceable and honorable in its dealings. Much light is thrown upon its social customs. A short vocabulary is added, from which I see that it was a member of the Yurok linguistic stock. It has since been removed to a reservation and is extinct, or nearly so.

QUESTIONS IN DEMOGRAPHY.

The Eighth International Congress of Hygiene and Demography will be held at Budapest, from the first to the ninth of September next. The demographic part will especially interest the anthropologist. The secretary general, Dr. C. Muller, Rochus Hospital, Budapest, will send full particulars.

The demographic wing includes historical demography, anthropometry, presided over by the well-known scientist, Dr. Aur. Torok, demography of the agricultural classes, of towns, etc., and the statistical study of bodily and mental defects. A number of definite questions are presented for investigation and discussion under each of these headings. It is to be hoped that the United States will not be without competent representatives at this important meeting.

THE NURAGHS OF SARDINIA.

The name *nurhag* is given in Sardinia to certain ancient stone structutes, which are very abundant in parts of the island. The walls are thick, the stones laid without mortar, well fitted together. The entrance is low and leads to interior chambers enclosed with ogival arches, giving the room the shape of half an egg-shell.

The builders and the date of construction of these edifices have been a puzzle from the days of Diodorus Siculus, who mentions them then as very ancient. A writer in *La Nature*, for October, 1893, reviewing the recent evidence obtained by excavation, shows that they were built by a people acquainted with bronze, copper, tin and lead; who wore metal helmets, and used metal swords; and hence lived in the bronze age. Basing his opinion on the character of these relics and supported by some very early classical traditions, he maintains that the builders were Libyans, who came from Africa, seized a portion of the island, populated it, and constructed these solid forts as refuges and defensive works.

To this it may be objected that similar buildings have not been discovered in north Africa; but it is also true that much of the territory there is unexplored; that the Roman occupation used the material of the old buildings for new ones; and that rumors have reached travellers of extensive and ancient stone ruins in the remoter valleys of the Atlas. The theory, therefore, is not without a fair probability in its favor.

[2] "Science Teaching in the Schools," by Wm. N. Rice, p. 10, (D. C. Heath & Co.)

EARTHQUAKES IN AUSTRALASIA.—III.

BY GEORGE HOGBEN, M. A., TIMARU, NEW ZEALAND.

REFERENCE has already been made to the first report (1891) of the Seismological Committee of the A.A.A.S. (see *Science*, vol. XXI., p. 344), which, with a paper by the present writer, included summaries of all the known records of earthquakes in New Zealand to the end of the year 1890. The second and third reports of the same committee (1892 and 1893) have continued that work to the close of last year, and have added thereto similar summaries for New South Wales, Victoria, South Australia and the New Hebrides. The committee have also had placed at their disposal the observations (made under the direction of the late Captain Shortt, R.N., meteorological observer at Hobart, Tasmania) of a most remarkable series of shocks that occurred in Tasmania during the years 1883–1886. The large number of these shocks (2540) made it undesirable, if not impossible, to publish, even in a brief form, the details of each earthquake; but the chief results have been analyzed in two papers read before the last meeting of the Australasian Association; of these mention will be made below. The most interesting part of the last report (1893) is perhaps that containing the records from the New Hebrides. These consist of careful notes made by a missionary—the Rev. W. Gray—stationed at the Island of Tanna, and form the first fruit of our work in the Pacific, as distinguished from that on the continent of Australia and in New Zealand. Tanna contains one of the three active volcanoes in the group, and eruptions are frequent; nevertheless, though the volcanic and seismic phenomena are probably not unconnected, a large number of the earthquakes do not seem to have the characteristics of those commonly classed as volcanic. One feature of the earthquakes of the New Hebrides is the remarkable rise of land that has on several occasions been observed to follow the shocks. Darwin alludes, it may be remembered, to the recent elevation of these islands ("Coral Islands," chap. vi.); it is interesting to notice that they are still rising, and by no means at a slow rate. In Steel's "New Hebrides" it is stated that elevations of land took place after the earthquakes of Jan. 10, 1878, and Feb. 14, 1878, of twenty and twelve feet respectively; and further that "rocks which were formerly covered with seven or eight fathoms of water are now above high-water mark" (Steel, "New Hebrides," p. 189). The rise in the last two cases appears to have been local in nature, at least as regards the magnitude of the elevation. Here and there in books and papers upon the New Hebrides allusions less definite in character may be found to elevations of land in other islands, especially Aneityum. The Rev. W. Gray has supplied, in a letter accompanying his observations of the New Hebrides earthquakes, very definite details of elevations of land following two earthquakes, in 1888, which I believe have not before been placed on record, though they are quite as striking as the historical case noted by Darwin as having occurred on the coast of South America in 1835. On April 20, 1888, an upheaval took place at Tanna, exposing a new beach 58 yards in width. Mr. Gray says, "On examining this part I walked over ground dry-shod where a year ago I sailed in a boat and where at one time there was thirty feet of water."

The earthquake of June 24, in the same year, extended the beach another 97 yards seawards, the total width of new beach being 155 yards. Unfortunately Mr. Gray does not give the vertical height through which the coast was raised; but his description seems to imply a total upheaval for the two earthquakes of 40 feet at least. Near the middle of the beach last formed he marks a spot thus: "At this spot our mission-vessel lost an anchor more than ten years ago. It was brought up now."

The New Hebrides are cut off from the Loyalty Islands and New Caledonia by a narrow but deep trough in the ocean bed; yet some of the earth movements in these groups seem to correspond with one another. In the absence of more exact information it is premature even to hazard a conjecture; but should a sufficient correspondence be established, it would seem to show, (1) a deep-seated cause for the disturbances, (2) a general movement of that part of the floor of the Pacific Ocean. We hope to get evidence on these points shortly.

Two papers of mine read before Section A of the A.A.A.S. (Sept., 1893) dealt, the one with "Earthquake-Intensity in Australasia," the other with the "Tasmanian Earthquake of January, 1892." The former was suggested by a paper by Dr. Edward S. Holden, Director of the Lick Observatory, entitled "Earthquake-Intensity in San Francisco" (*American Journal of Science*, June, 1888). Dr. Holden gave therein the equivalents of the degrees of intensity of earthquake-shocks on the Rossi-Forel scale, in terms of the acceleration due to the velocity of the shock itself, expressed in millimetres per second; he then applied his table to form an estimate of the intensity of the shocks felt in San Francisco. I have done the same for the Australasian Colonies. For New Zealand we have for the years 1848–1892 the records of 926 earthquakes; but in the earliest years only the severest shocks were recorded, and until December, 1889, when the present system of observation through the officers of the Telegraph Department was begun, most of the shocks of intensity I. to III. on the R.-F. scale were probably neglected. Now comparatively few pass unnoticed; I have therefore taken the records for the three years, 1890–1892, only. The number of shocks is 198, and the mean average intensity per shock, as felt in New Zealand, is 72 m.m. per second, that is to say, between III. and IV. on the Rossi-Forel scale, or sufficient to make pictures move a little and to cause some doors and windows to rattle slightly.

For New South Wales (12 years) and Victoria (8 years) the average intensity is about IV.; but the records evidently omit nearly all the slighter shocks, and so this estimate is undoubtedly much too high. In South Australia, where somewhat fuller records were kept, the average intensity (10 years) is only a little over III. on the R.-F. scale.

The study of the remarkable series of earthquakes in Tasmania and southeast Australia, between April, 1883, and December, 1886, in conjunction with the determination of the origins of the principal shocks, opens up several questions of great importance, which it would take too long to discuss here. The total number of shocks for the 45 months was 2540, an average of 56.4 shocks per month, which would be sufficiently startling were it not that the average intensity of shock was only between III. and IV. (71 m.m. on the absolute scale). One month, October, 1883, enjoys the questionable distinction of having 231 shocks recorded against it, that is, seven or eight shocks a day; and November of the same year is not far behind. A second maximum of intensity was reached in August, 1884; and then a very gradual decline took place for nearly 2 1/2 years, the shocks slowly dying away at the end of 1886. The only considerable earthquake since then is that of January 27, 1892, felt all over Tasmania and in southeast Australia, for which the data were sufficient to determine the origin very nearly. It is situated below the deep trough of the Tasman Sea, about 353 miles east of Launceston and 365 miles from Hobart. The chief shocks of 1883–1886 may be referred with more or less probability to the same neighborhood; but many of the smaller shocks were more local. For 3 or 4 years a re-adjustment of the earth's crust was going on steadily; the larger shocks were perhaps merely in-

cidents caused by movements a little more rapid than usual, or by the sudden slipping of large masses out of the position of unstable equilibrium into which the slow movements had brought them. If these large or primary movements were fault-movements, one would almost expect to find the axis on the edge, and not in the middle or at the bottom of a steep trough in the ocean-bed. If the primary movement, on the other hand, was principally one of revolution about the axis, interrupted by an occasional sliding of the mass on one side of the axis upon the mass on the other, then we must look for secondary movements at some distance from the axis, where the displacement caused by revolution is naturally greater. Is it possible that the lesser shocks were more or less local movements of this character? It is curious to notice that the total intensity of the series of shocks amounts to 186,690 absolute units, or about 19 times the acceleration due to gravity. The large expenditure of energy implied by this total suggests at least a possibility of a very appreciable amount of movement in the land-mass of Tasmania and southeastern Australia. Though, so far as I know, there is no evidence of elevation or depression, one does not like to think of Mother Earth wasting so much of her strength for naught.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as a proof of good faith.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The Editor will be glad to publish any queries consonant with the character of the journal.

Volcanic Rocks in the Keewatin.

In view of the article published in *Science*, No. 571, entitled "Volcanic Rocks in the Keewatin of Minnesota," and the very numerous recent papers on the same subject, viz.: "Archæan Volcanic Rocks," it may be interesting to your readers, and, in any case, I think it is fair to myself, to publish the following letter of mine on the same subject, which was written fourteen years ago. Any comments by me are, I think, unnecessary.

Alfred R. C. Selwyn,
Deputy Head and Director,
Geological Survey Dept., Ottawa.

"Montreal, 9 December, 1879.

"My dear Professor Dana:

"I have just read your remarks[1] in reference to what I have ventured to call the Volcanic Group of the Quebec series of Sir W. E. Logan. I should like very much to know exactly what your views on this question are, and hope at some future time to hear them from yourself personally. In the meantime I would make a few explanatory remarks on the points you refer to in my paper. You say, 'The evidence of the general volcanic origin of the second group is not stated and the kind of rocks mentioned make a remarkable assemblage to be spoken of as these volcanic rocks.' This would seem as if I had meant to assert that all the rocks mentioned as constituting the group were of volcanic origin. I might certainly have made the matter plainer had I specified those rocks in the group which there were reasons for supposing to be of volcanic origin. It never occurred to me, however, that in giving a general description of a group of strata[2] of mixed volcanic and *ordinary* sedimentary origin it would be necessary to do so. As regards the evidence of a volcanic origin, of some of them I can only say now that it is of precisely the same kind as that which, in respect of similar British strata, has been considered to be conclusive by almost every British geologist of note, including De la Beche, Lyell,[3] Murchison, Sedgwick, Jukes,[4] Scrope and a host of others now living.[5] Further, that these conclusions, first arrived at by the most careful and minute geological investigations and mapping of the stratigraphy, have been, or are supposed to be, entirely confirmed by the, comparatively recent, microscopical and chemical investigations of these same rocks.

"It is now rather more than thirty years since I took an active part, under the geologist I have first named, in working out in all their intricate details the great Lower Silurian and Cambrian and older volcanic series of north Wales. Since then I have had abundant and world-wide opportunities of studying volcanic formations of all ages, recent, Tertiary, Mesozoic and Palæozoic, and I may say that it is on the result of this world-wide geological investigation and experience, and not on the occurrence of labradorite or any other particular mineral, that I have come to the conclusion that we have in Canada, as in Great Britain and elsewhere, good evidence of the existence of volcanic strata, and consequently of volcanoes, in Silurian or Cambrian and pre-Cambrian epochs. I am quite aware that most of the peculiar rocks, which, in common with a majority of British and some American geologists, I hold to be of volcanic origin, have heretofore been generally, and doubtless quite correctly, described simply as 'crystalline,' 'metamorphic,' or 'igneous' rocks. But this, it seems to me, does not refer so much to the question of their origin, as it does to that of their present condition and character, and if we carefully study their stratigraphical relations in the field, and their microscopic and physical characters, we at once find—at least, such has been my experience—that some other explanation of their origin and associations is required besides that of their being ordinary sedimentary deposits in a metamorphic condition. Indeed, your own and Mr. Hawe's careful and admirable investigations of the chloritic formation in the New Haven region seem to me to demonstrate the entire probability, to say the least, of the igneous and volcanic origin of the rocks you describe. It is, I believe, generally admitted that rocks having the mineral and physical peculiarities characteristic of many volcanic products would be more easily affected by metamorphic agencies, especially hydration, than those which are of ordinary and unmixed sedimentary origin and that these old volcanic rocks should have assumed these metamorphic or altered characters is, of course, what might be expected and their having done so certainly does not negative the supposition of their volcanic origin. It seems to me that *à priori* probabilities of the existence of volcanoes in Eozoic and Palæozoic epochs are very strong and that those who oppose any such idea should be prepared, like those who hold the opposite opinion, to state some good reason for their views, and also the particular geological epoch when, in their opinion, volcanic outbursts first occurred. If, on the other hand, the existence of volcanoes in these early geological epochs is admitted, then we may very naturally expect to find their products associated with the ordinary sedimentary rocks of the period, in the same manner as we do those of the volcanoes of recent and Tertiary times. And this is what British geologists generally claim to have done. I have no wish to dogmatise on this question and only desire the truth, whatever that may be; but at present I cannot help feeling that if I am in error, I am so in very excellent company, and that the views of such eminent geologists as I have named, and based, as I know

[1] *American Journal of Science*, vol. xv., 1879.
[2] Now, 1891, appropriately termed "*pyroclastic*."
[3] *Vide* Lyell's "Elements of Geolo . . ." 6th ed., pp. 605, 631.
[4] *Vide* Jukes's "Manual," 2nd ed., p. 21.
[5] *Vide* Ramsay, "Memoirs," Geological Survey of Great Britain, vol. iii., chap. 5

them to have been, from intimate personal acquaintance, both with the men and with the country to which they were applied on precisely the same evidence as is to be found in Canada, are at least entitled to be regarded as something more than 'fancy sketches.'

"I am, my dear Professor Dana,

"Very truly yours,

"(signed) ALFRED R. C. SELWYN."

Inquiry Regarding Fresh-water Pearl Fisheries.

I ENCLOSE herewith a circular of queries that I am very desirous of having answered to assist in carrying out an investigation in regard to the locations, yield and proper protection of fresh-water pearl fisheries in the United States. All correspondence on this subject should be addressed to me as follows: G. F. K., care of United States Commission of Fish and Fisheries, Washington, D. C.

GEORGE F. KUNZ.

LIST OF QUESTIONS.

The pearl-bearing mussels: 1. Nature of stream in which found, kind of bottom, character of water; 2. Geological character of the district as to rock, soil, etc.; 3. General abundance of mussels; 4. Size, shape, and position of the mussel beds; 5. Local names of mussels; 6. Habits of mussels; 7. Enemies and fatalities to which mussels are exposed, nature and extent of destruction by muskrats, hogs, freshets, etc.; 8. Size, shape, and color of mussels; 9. Species of mussels in which pearls are most common; 10. Proportion of mussels in which pearls occur; 11. Sizes, or other peculiarities, of shells in which pearls are found. The pearls: 12. Nature and origin of pearls; 13. Position in mussel; 14. Size, shape, and color of pearls; 15. Relative value of pearls of different sizes, shapes, and colors; 16. Markets for pearls; 17. Prices for pearls. The fishery: 18. Method of taking the mussels; 19. Description of apparatus used in taking mussels and in opening the shells; 20. Methods of extracting the pearls; 21. Treatment of pearls when found; 22. Utilization of mussels after extraction of pearls or after opening; 23. Principal occupations of mussel fishermen; 24. Statistics of fishery in 1893: Fishermen, number; Boats, number, value; Apparatus, number, value; Pearls, number, value; 25. Statistics, complete or partial, for previous years; 26. Period when pearl fishing was of greatest importance in district; 27. History of origin and growth of fishery; 28. Exhaustion of mussel beds, causes, rapidity; 29. Do exhausted beds become replenished, and in what time? 30. Is State protection of beds desirable or necessary?

Psuedo-aurora.

THIS phenomenon has again, this winter, been of unusual beauty and brilliancy over lights in this city. The following is an explanation of the occurrence: The phenomenon is not a shadow effect, as explained by Mr. Hazen in a number of last year's *Science;* neither has it any electrical significance, as has been indicated by several writers. It has a true light effect and consists of an apparent bright shaft of light extending upwards to the zenith over bright lights. If the lights are swung high it may also be seen extending from the light to the earth. It only occurs under certain atmospheric conditions, which are about as follows: Cold, cloudless nights, with but slight wind, if any, following upon an atmospheric humidity approaching saturation. Under these conditions, small, almost solid, flat, hexagonal ice crystals fall in a constant mist, glistening in a strong light, like particles of diamond dust. It is in the peculiar flat, light form of these crystals, associated with the manner in which they fall, that explanation of the phenomenon rests.

Leaves falling from trees, during a calm, preserve, during the chief part of the descent, the horizontal position. This is found by careful observation to be alike true of the fall of the flat, hexagonal ice particles at the times when pseudo-aurora occur. The rays of light from the lamp or other brilliant light, striking the under flat surfaces of the crystals, are simply reflected to the eye of the observer; and the eye receives rays reflected from all particles of ice within the vertical plane through the eye and through the lamp or source of light, referring the grand final light effect to the vertical.

That it is not of an electrical nature is evident in that some of the most brilliant shafts occur over bonfires, and when the moon is low in the horizon, on nights showing the aurora, it is seen to cause the same phenomenon.

H. L. BOLLEY.

Fargo, North Dakota.

Notes and Queries.

Rubus strigasus is rather common in Waterbury, Conn., but I have never found it bearing perfect fruit (except as noted below). The canes are quite as strong and thrifty as any found in northern New England, and plenty of flowers are produced, but rarely more than two or three drupelets in a berry ever mature.

My observations extend over a period of more than thirty years. At present the plant is much more abundant than formerly, but the failure of the fruit to mature is the same as at first. Asking Dr. Asa Gray, at a meeting of the Botanical Section of the A.A.A.S., several years ago the cause of this, he remarked that "he should like to see the flowers" before answering.

Of course it is because they are not *fertilized*, but why are they not? Honey bees here, as further north, find the raspberry blossoms a rich source of honey, and any part they may take in the fertilizing process ought to be as effective here as in other sections. The exception to this sterility makes the sterility still more singular. Along the ditches through some of our shallow peat bogs this red raspberry grows, sometimes, very rank and tall, and it is not rare to find, in September and October, the terminal portion of the year's growth full of blossoms and perfect but unripe fruit. I have seen these berries fully grown, very large, but none quite ripe, though they probably do ripen in warm seasons. There is a cause for this failure of the summer crop, but what is it? I believe the cultivated species and varieties of the raspberry do as well here as anywhere. It is well understood that the failure of the first crop of red clover to produce many seeds is because the bumble-bees, the only insects that frequent its flowers for honey, are too few to transfer the pollen.

This cannot be the case with the raspberry. It may be found that the honey-bee, wholly intent on gathering honey, neglects the pollen altogether and that the pollen gatherers prefer that of some other flowers found here. The interrelations between plants and insects are not all yet found out, but the suggestion made above may have no foundation in fact.

Thirty years ago the farm yards and road sides in western Connecticut were white in the summer from the abundance of the flowers of the May weed (*Maruta Cotula*). A few years later—but just when no one can tell, for it passed without observation—this plant disappeared entirely. For years not a single specimen could be found. It is now slowly reappearing, but not yet abundant. Over how large a part of the country this disappearance took place I cannot say, for my observations did not extend far beyond Waterbury and the adjacent towns.

Here, as in numberless other cases, the ever-recurring *why* appears. Certainly no *apparent* cause banished this

hardy annual. This is not a solitary instance of this sort, but I do not remember to have seen any explanation of such facts. H. F. BASSETT.

Waterbury, Conn.

Chilopoda Migrating in Broad Day-light.

SEVERAL years ago a friend of the writer saw, during late summer in Nebraska, a great number of some chilopod migrating in the day-time. They were all going in one direction across a road where they were readily seen, and continued to pass over it for more than a week. A very dry spell from which the country had been suffering may have had something to do with the movements of the animals, for they disappeared after a heavy rain. The fact that they were seen in large numbers, as well as their migrating in broad day-light, is very interesting, since none of the Chilopoda are usually seen in great numbers or where there is much light. Repeated questions, however, showed that the animals were some chilopod, probably a *Scolopendra*, since they were too large for a *Lithobius* and can scarcely have been a *Scolopocryptops*.

If any reader has ever seen any of the Chilopoda migrating at any time, or in very large numbers, he will confer a favor upon the writer at least by letting him know through the columns of *Science*, or by letter, the locality, season, state of weather, duration of migration and if possible the species observed. F. C. KENYON.

College Hill, Mass.

A Miniature Water Lily.

IN reply to Prof. J. E. Todd's inquiry of Dec. 15, his Nymphaca found near Red Lake is very interesting, as it is undoubtedly *N. odorata Ait.*, var. *Minor sims.*, and the location is between that reported by J. M. Macoun from Moose River, near James Bay, in 1885, and that reported by the Natural History and Geological Survey of Minnesota, in Turtle Lake, Otter Tail Co., Minn., in 1883.

H. B. AYRES.

Corn.---A Query.

LATE last fall a friend found a peculiar ear of corn growing in his garden. He had planted ordinary sugar corn and was much surprised to find an ear each grain of which had a distinct shuck, besides the ordinary shuck on the outside. The ear is of average size, although the cob is rather small. Similar corn had been exhibited at the county fair a few years before. Is this corn going back to some earlier form? E. M. DANGLADE.

Vevay, Ind.

Rope of Maggots.

PROFESSOR WILLISTON, in his note, "An Explanation of the Rope of Maggots," remarks that the phenomenon has been but seldom observed in America, whlch leads me to give a couple of observations of my own, in Indiana. On the Campus of Purdue University is a hedge of Norway spruce, along one side of which is a drive, and on the other a walk of gravel and cinders, both raised somewhat above the level of the ground. On July 10, 1888, following a rainfall of 3 inches, vast numbers of these larvæ formed "ropes" covering a width of from one half to two inches, marching out from the hedge and following along the walk for a considerable distance, when they would return again to the hedge, crawling in and about the latter with seemingly no especial object in view, though it was here that the maximum in width of column of march was reached. There were several separate "armies," each following an independent winding course, but separated from each other by short distances. A considerable number were placed in a breeding jar on grassy sod, where they again took up their line of march, forming a ring around the outer edge of the grassy disc. They continued to crawl around and around this edge for some time, forming a "rope" the size of one's finger.

On July 15, 1889, the day following a rainfall of 1.22 inches, I again witnessed a precisely similar phenomenon and in the exact locality on the walk where it had taken place the previous year. This appeared to me to indicate a tendency to local, permanent breeding places, the larvæ subsisting on decaying vegetation and in this case the foliage of the spruce. It would also appear that these larvæ had in each case been driven out of their quarters by the water collecting therein. F. M. WEBSTER.

Wooster, Ohio.

BOOK REVIEWS.

Pain, Pleasure and Æsthetics. By HENRY RUTGERS MARSHALL. New York, Macmillan & Co. $3.

THE object of this work is to present a theory of pain and pleasure, and from that as a basis to develop a philosophy of art. The author has evidently given a great deal of time and thought to his subject, and has made a careful study of the views of others, as well as of the psychological principles involved. Mr. Marshall begins his discussion by remarking on the difficulty of finding a word to designate both pleasure and pain, the word *feeling*, which some writers use, being, in his opinion, too varying and ambiguous in meaning, while *sensation* and *emotion* are not only ambiguous but much too narrow; hence he uses the compound word *pleasure-pain* as the only available term to cover the two kinds of phenomena in question while excluding everything else. He then proceeds to inquire what pleasures and pains in their nature are and how they are related to the other phases of consciousness. The common theory is that the states of consciousness that we call feelings, or pleasures and pains, are a distinct class of mental phenomena co-ordinate with thought and action yet inseparably connected with them. Mr. Marshall believes this to be an error, and maintains that they are *qualities* of the other states of consciousness, or, in his own words, "Pleasure-pain modes are *quales* of all mental states: qualities, one of which must, and any of which may, belong to any element of consciousness" (p. 45). This theory he supports with many arguments, accompanied by criticisms of other views, and then enters on an elaborate discussion of the physical basis of pleasure and pain, to which we can only refer our readers, as it is much too difficult and detailed to be analyzed here. We find ourselves, however, unable to accept his theory of what pleasure and pain are, notwithstanding the considerations urged in its favor. That some feeling of pleasure or pain accompanies every mental state, whether thought, sensation, volition or any other, is undoubtedly true; but we cannot bring ourselves to regard the pleasure or pain as a quality of the given state. A pleasure generally accompanies a new thought; but the pleasure seems to be a distinct phase of consciousness rather than a quality of the thought itself. Nor can we regard the feeling of compunction which often attends the doing of a wrongful act as a quality of the act or of the moral judgment that reason passes upon the act. But the subject of the feelings is so difficult that the arguments of an intelligent thinker can hardly fail to be useful, whether one agrees with his views or not.

Mr. Marshall's theory of pain and pleasure, however, is only a part of the doctrine set forth in this book; he bases on it a theory of beauty and of the aims and motives of art. "The art impulse," he thinks, "is a blind impulse which leads men to create with little or no notion

of the end they have in view"; but that the end to which this impulse really leads is the attraction of other persons by pleasing them. It follows, therefore, that a work of art is to be estimated according to the pleasure it produces, or, as the author himself expresses it: "That object is to be considered beautiful which produces a psychosis that is permanently pleasurable in revival. Each pleasure may form an element of impression in an æsthetic complex; but only those pleasures are judged to be æsthetic which (relatively speaking) are permanently pleasurable in memory. . . . We are led also to the further conclution that that object is to be considered ugly which produces a psychosis that is permanently disagreeable in revival" (p. 110). The pleasure which the beautiful object produces may be of any kind that has the quality referred to—that of being permanent in revival; and consequently men's judgments about what is beautiful will vary according to the kind of pleasure they most enjoy, or, in the author's words: "For each person the æsthetic field to which he refers in making judgments as to beauty is his relatively permanent pleasure-field of revival." From this theory it follows that the aim of the artist in his work should be to produce as great and as varied pleasures as possible unaccompanied by pain.

Now that the end at which art aims, or at least one of its ends, is what Aristotle called "noble pleasure" will be admitted by all, and the pleasures it produces are undoubtedly of the kind that Mr. Marshall refers to, but is it correct to say that all the pleasures that a work of art produces are due to its beauty? It seems to us, rather, that the pleasures produced by beauty are of a special kind, and that many of the pleasures that we experience in contemplating a work of art are due to other qualities than its beauty. A religious song, for instance, may awaken religious emotion, and a patriotic song may awaken patriotic emotion, but these pleasures appear to be quite different from that produced in both cases by the beauty of the song, and it is obviously possible to have either of the former feelings when no beautiful object is present. Mr. Marshall's art theory, however, contains much that is true and valuable, and is worthy of attention from both artists and psychologists.

A Standard Dictionary of the English Language. Vol. I., quarto. New York, Funk and Wagnalls Company.

THE preparation of this dictionary was begun nearly four years ago, and it is expected that the work will be completed by the issue of the second volume in June of the present year. The editor-in-chief is Dr. Isaac K. Funk, the head of the firm that publishes it; the managing editor is Dr. D. S. Gregory, who has also had special charge of the definitions in philosophy and theology. Professor F. A. March has had charge of the spelling and pronunciation; and there have been, besides these, several assistant editors and many writers on special topics. The dictionary, when completed, will contain two hundred and eighty thousand words, which is a much larger number than is found in any other English dictionary, the Century Dictionary having only two hundred and twenty-five thousand, and other dictionaries a still smaller number. The dictionary will be issued in two volumes of over a thousand pages each, and also in a single volume; and it seems likely to take a prominent place among the wordbooks of the English language.

The dictionary has certain distinguishing features, some of which, we believe, are entirely original, and are deemed by the editors decided improvements. The most prominent of these, and the one on which the most stress is laid, is the practice of giving the most common meaning

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of a word first and the other meanings afterwards, without regard to logical order or historical precedence; as a consequence of which it frequently happens that some special meaning stands first and the general meaning follows. For instance, *allegiance* is first defined as "the obligation of fidelity and obedience that an individual owes to his government or sovereign, in return for the protection he receives," and then as "the obligation of fidelity in general, as to a superior or to a principle." The reason given for this arrangement is that the most common meaning is the one most frequently sought for, a proposition which as regards the ordinary words of literature we incline to doubt, as most persons who will consult such a dictionary as this are already familiar with the usual meaning of such words, and will turn to the dictionary either for some rarer meaning or to trace the etymology of the word and the logical development of its various significations. For these purposes it is obvious that the arrangement here adopted will not serve, yet experience only can determine which arrangement is better.

The editors are interested in spelling reform, and though they have not attempted to change the established orthography, they have used the alphabet devised by a committee of the American Philological Association to indicate the pronunciation of words, which purpose it serves fairly well, though some of the vowel characters are used in a way that will be strange to the merely English reader. Scientific terms have been defined by experts in the various subjects to which they relate, and we note that the editors have adopted certain changes in the spelling of chemical terms advocated by the chemical section of the American Association for the Advancement of Science. The dictionary is well printed, as, indeed, a dictionary in these times must be, and the illustrations, nearly five thousand in number, add to the usefulness and attractiveness of the work.

Domestic Science. By JAMES E. TALMAGE, D.S.D., Ph.D., F.R.M.S. Salt Lake City, Geo. Q. Cannon and Sons Co. 2nd Edit., 389 p.

THIS is an admirable little work containing a systematic review of those principles of science which we encounter constantly in our daily life. Familiarity has lead us to accept without thought the many details of household routine, but by so doing there is lost to us a vast amount of enjoyment which may be had by a clear understanding of the phenomena we see about us. The laws of nature enter into the most commonplace, and most of us would be surprised to discover how "near home" are chemistry and physics. We are only too apt to look upon these sciences as special studies for university scholars, as something apart from and foreign to our every-day life, while in reality we are constantly, as it were, at work in a laboratory applying principles of science and carrying on experiments. Dr. Talmage's work is now in its second and revised edition, having been somewhat altered to better meet the needs of students. The four main divisions are divided into chapters, the subject being treated under the general heads of air and ventilation; heating and lighting; water, its character, impurities, and purification; foods and cookery; cleansing agents; bleaching; poisons and their antidotes. It is safe to say that the students of "Domestic Science" (it has already been adopted in all the district schools of Utah) will gain a vastly greater amount of useful and permanent scientific knowledge than will those who have pursued only the customary text book course in chemistry and physics.

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KARYOKINETIC FIGURES IN MAMMALIAN TISSUES.—Since the publication of my Preliminary Notice in *Science* for Dec. 1, 1893, many parties have written me asking for permanent preparations showing mitosis. To these parties I have sent slides, and I now offer to all who desire them slides showing mitotic figures in nuclei of embryo kitten. A good immersion objective is necessary to make out the figures satisfactorily. Send 60 cents in stamps. If the slide is not satisfactory, return it, and I will return the money. I do not care to exchange slides. Frank S. Aby, State University, Iowa City, Iowa.

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CONTENTS.

SOME ITALIAN "SURVIVALS"—A "LONG HOUSE IN THE TIBER DELTA." Robert H. Lamborn . 113

MEMORABILIA BOTANICA, II. Edited by Erwin F. Smith 115

THE BOTANICAL LANDSCAPE. J. W. Chickering . 118

BOTANY IN THE SCHOOLS. Katherine E. Golden . 119

SOME REMARKABLE HOT SPRINGS AND ASSOCIATED MINERAL DEPOSITS IN COLUSA COUNTY, CALIFORNIA. Harold W. Fairbanks 120

LETTERS TO THE EDITOR:

THE DATA OF BIRD FLIGHT. Willard D. Johnson 121

THE MINING BUILDING AT CHICAGO. E. O. Hovey. 122

PETRIFIED EYES. A. R. Crook 122

BOOK-REVIEWS 123

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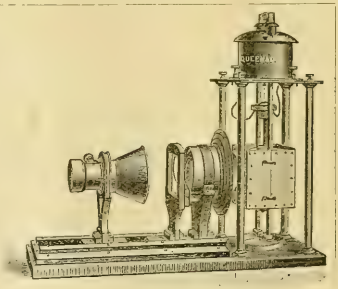

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IS it not true that, in a vague way, the usual conception of the cause of damage by lightning is that something (in past ages a "thunderbolt") comes down from the thunder cloud to do the damage? Is it not true that since damage is done by lightning we should seek the mass of matter in which this energy must exist just before the flash? Is it not equally true that since Faraday's time we have known that this energy exists in the column of dielectric (mainly air) extending from the cloud to the earth? Do we not know since Lord Kelvin's experiments that this energy exists in the air on account of a state of electrical stress, which stress cannot exceed .0075 of a pound per square inch, and that consequently the amount of energy in each cubic foot of air cannot exceed about one foot-pound?

Knowing that the energy just before the flash exists in the column of air between the cloud and the earth, which column is indicated in the figure by the dotted lines, and that when the air "breaks down" and the flash comes this energy manifests itself mainly as heat along the central core of this column in what we call a flash of lightning, is it not evident that the energy must be transmitted in lines perpendicular to the lines of electrical stress, *i.e.*, in the main horizontally, indicated in the figure by the arrows?

From all this, which is a part of our current knowledge, it appears that the problem of protection from lightning is a problem in the dissipation of energy; that the energy to be dissipated, while we know it to be considerable, as broken masonry testifies, is but a small part of the whole involved in a flash of lightning, by far the larger part being dissipated as heat above the roofs of our houses. If the conditions can be so arranged, by the use of considerable masses of metal suitably placed, that there shall be no state of stress below the roof of the house, then there will be no energy to be dissipated below that level, and all will go well. But it is surely time that the problem of protecting buildings from lightning should be looked upon as one in energetics and that it should be appreciated that the energy present cannot be hocus-pocussed out of the way but must be dissipated in some harmless manner.

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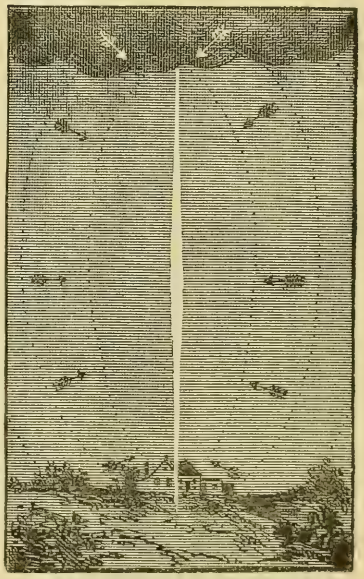

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First inserted June 19, 1891. No response to date.

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SCIENCE

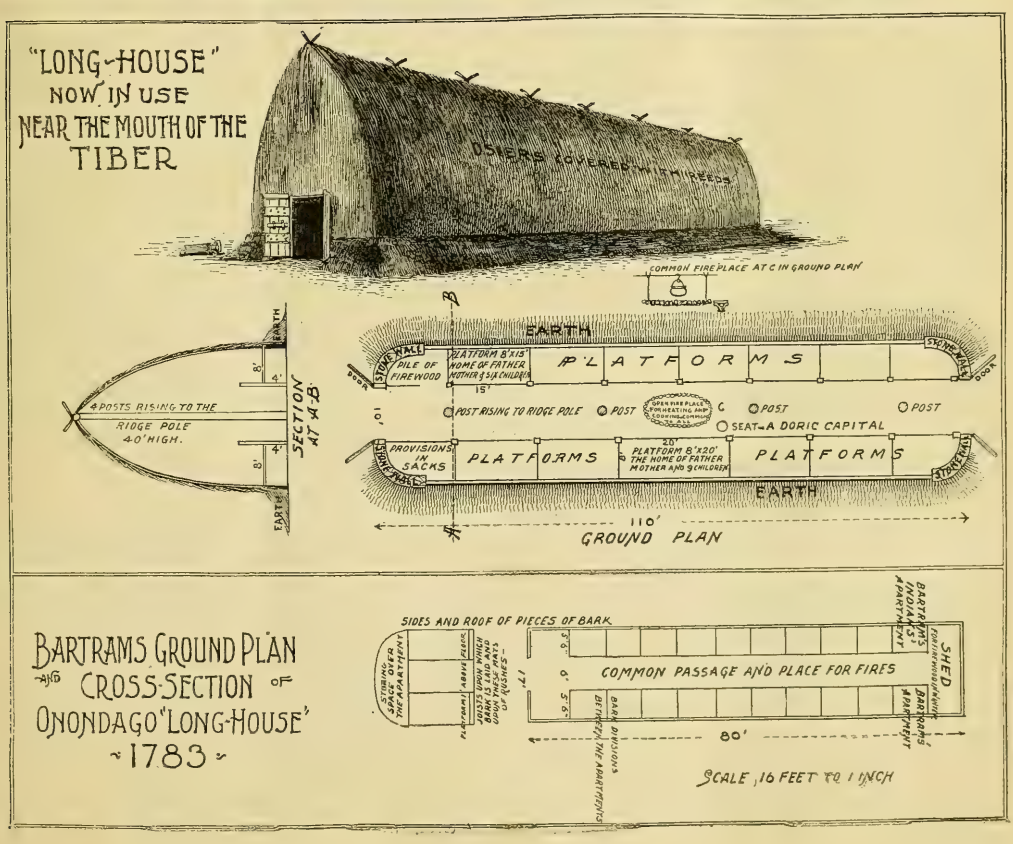
NEW YORK, MARCH 2, 1894.

SOME ITALIAN "SURVIVALS"—A "LONG-HOUSE" IN THE TIBER DELTA.

BY ROBERT H. LAMBORN, PH.D.

AROUND the Eternal City, within easy riding distance, one may study many surprising phases of civilization. Six miles north-eastward across the Campagna from the Porto del Populo, in a secluded valley far from the beaten roads, on the lands of Prince Borghese, I found several families numbering 26 persons, living in caves with their shaggy white dogs. They subsisted by gathering wild chiccory for Roman salad-eaters, and by begging for alms at the city gates. A furlong from this cave is a veritable cliff dwelling. A deep cavity in an almost perpendicular escarpment of tufa rock is reached by a zig-zag path. Its entrance is closed by a swinging bundle of bush, and within, the irregular floor is divided by rough stone walls into pens resembling those in a Colorado cliff-dweller's habitation. On the western slope of the Alban Hills I once dismounted to inspect a flour mill owned by the Cenci family, where the vertical shaft of a horizontal flutterwheel carries the diminutive grinding stone and the water flowing from a historic Etruscan drainage-tunnel shoots down a steep stone channel, and dashing out a sparkling shower, whirls the toy-like wheel with all the prettiness and childish carelessness of force-expenditure that one may see in a New Mexican Indian corn-mill. The shepherds on the broad domain of Prince Torlonia live in beehive-shaped *capanne*, built of brush and reeds almost as simple in construction as the dwelling reared by our western beaver. Their rent they pay weekly by selling ewes' cheese, made over a fire kindled on the earthern floor close to the bunk in which the shepherds sleep.

On April 13, 1888, I rode by the Via Ostia, through the Tiber Valley, to the district where that river divides and enters the Mediterranean. I reached, not far from the sea, the property of Prince Aldobrandini and soon approached his country seat, near which arise



four curious and conspicuous structures, in close proximity to the roadway. At first they seemed to be huge hay-stacks, the stored herbage of Tiber's fertile delta, but nearer inspection proved them to be houses. It was quickly evident, too, that they did not lack inhabitants, for a number of women and children flocked from an opening in the eastern end of the largest structure, and stood awaiting my approach. I was so strongly reminded of the "Long House" of the Onondaga Indians as given by Morgan (after Bartram) in his "House Life of the American Aborigines," that I handed my reins to a young man who had approached expectantly and entered the open doorway; men and women coming forward with alacrity to show me the interior economy. I was told that this, with the three additional structures, were the dwellings of the laborers on the Aldobrandini estate, and that about 70 of the total population of about 250 found in this house their home. Its form is best shown by the accompanying sketches made in my note book on the spot. It is 110 feet long, about 26 feet wide, and is drawn to a comb about 40 feet above the ground. Vertical and horizontal poles form the framework, upon which are fastened osier walls, overlaid by flags and reeds gathered from the neighboring lagoons, thus producing a wind and rain proof covering. The storms and sunshine of years falling upon this thatch of water plants gradually change their color until the exterior is as black as a stack of clover hay. Only two openings, one at each end, admit you to this windowless house, and these are closed at night by heavy plank doors that are swung together and securely barred. In the corner to the left was a pile of dry faggots, the common property of the community. This fuel is burned upon a hearth that occupies a central point upon the earthen floor. Over a smouldering fire on this hearth a brass kettle was simmering, and a wreath of smoke ascended into the gloomy chimneyless upper-spaces. On both sides of the middle passage way, and raised about four feet above it, was a long platform of rough plank. These platforms were divided by board partitions, about three feet high, into pens varying in length according to the number of persons intended to be accommodated, but averaging for each individual a floor space of about two feet by eight. Thus to one family of eleven persons was apportioned a pen twenty feet long by eight wide, which answered for them every purpose of a home: another, fifteen feet by eight, was occupied by a father, mother and six children. These divisions held the boxes, clothing and sleeping arrangements of the family. In them children were playing, mothers nursing, and several sick persons were lying wrapped in dark woolen blankets.

I see no reason to believe that this structure, and the method of living practised therein, varies essentially from that which existed in the Maremma when Pliny possessed a villa near this spot, and when Cæsar drew his soldiers from among the forebears of these Roman peasants. We all know how slowly the habits of the lower classes change in old countries, and even residences in the most enlightened Italian districts show but little development since imperial times. Göethe relates that after visiting Pompeii with Tishbein, in 1787, he entered a neighboring occupied dwelling which with its furniture seemed to him to resemble perfectly the habitations he had just studied in the mummied city, built more than twenty centuries ago. Indeed it is possible that this curious Aldobrandini dwelling is a survival closely imitating the form of house constructed by tribes that dwelt in this valley long before Rome was founded—when the Capitoline hill was a sheep fold in the pre-historic period of the Ausonian peninsula. This possibility is strengthened by the fact that all the materials for the house are of local production, are easy to transport and require only the simplest tools to assemble and erect, while the result is an enduring and excellent shelter. An additional and striking evidence of the aboriginal character of the structure is the close parallelism shown in the American "Long House" already mentioned, which was habitually built and inhabited by some of our best known savage tribes. For purposes of comparison I have reproduced here Bartram's sketch of the Onondaga "Long House," made on the occasion of his visit to attend a council of that tribe in 1743. It was 80 feet long and 17 feet wide. A common passage, in which the fires were built, ran between two sets of occupied apartments. These apartments were raised about a foot above the level of the passage on two platforms made of hewn saplings, that extended along both sides of the house. They were formed by erecting bark partitions upon the platforms, and one division was allotted to each family. Soft pieces of dry bark and sleeping-mats were spread upon the rough floor, and a fire for each four apartments kept the house warm and served for cooking. Above each fire a vent in the roof allowed the smoke to escape. Extending over the apartments was a sort of second story in which household effects could be deposited. A corner in this dwelling was devoted to the common store of firewood.

"Long Houses," resembling the one pictured by Bartram, are described by Greenbalge, who visited the village of the Iriquois-Senecas near the present site of Rochester, in New York, in 1677. One was about 100 feet in length, made of a strong framework of poles set in the ground and covered with strips of elm-bark tied to this frame with strings. The living apartments were arranged as described in the Onondaga house. Skins, forming curtains, hung over the entrances, and from the roof were suspended bunches of Indian corn ears with their husks braided, and festoons of bits of dried squashes and pumpkins strung upon long pieces of cord.

My visit to this cheerful community in the Tiber delta, I regret to say, was too brief to allow me to enter upon the study of its domestic economy. Valuable material for comparison with the Indian customs would be obtained by investigating how far the property and supplies, such as firewood and food, are procured and held in common, and what household habits had developed to increase the convenience and comfort of families crowded into a place so restricted. But my destination that day was further southward along the blue Mediterranean, to the beautiful Castle Fusiano, with its vast domain of towering pine trees, where for miles one may gallop over smooth roads made fragrant by myrtle and sweet daphne, with long level reaches where the shadows are as profound as those that darken the primeval forests of the Allegheneys.

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MEMORABILIA BOTANICA, II.

(Edited by Erwin F. Smith, B.S., D.S., Washington, D.C.)

A JOURNEY INTO THE TROPICS.

In recent years the botanical garden at Buitenzorg, Java, has become a sort of Mecca for European botanists. Solms-Laubach, Schimper, Goebel, and many others have there studied tropical vegetation. Probably no other botanical garden in the tropics offers as good facilities for study, and certainly no other is so well-equipped, has been used as extensively or has been productive of anything like as much good work.

One of the results of a sojourn at Buitenzorg is a new book of 300 pp. by Dr. Haberlandt ("Eine Botanische Tropenreise") giving travel sketches and graphic accounts of the Indo-Malaysian vegetation. The author has not confined himself to dry dissertations, but has had his eyes open to the biological side of botany, has known how wisely to omit, and has mixed in enough general observations and human interest to make a readable book and one of considerable general interest, even without the useful illustrations of characteristic vegetation, reproduced from pencil drawings. To describe all the interesting things in this book would be nearly equivalent to translating it. It must suffice, therefore, to call attention to some of the leading features. The book begins with the departure from Triest; gives a chapter or two on the outward voyage, including some account of Bombay; describes the garden at Buitenzorg; discusses its climate and devotes a chapter to each of the following topics: The tree of the tropics, tropical foliage, flowers and fruits of the tropics, lianas, epiphytes, tropical ant-plants, the primeval forest, the mangroves, etc. The reader will also find fresh and interesting notes on a variety of cultivated plants,—tea, coffee, rice, cocoa-nut, cinnamon, cinchona, banana, etc. Various excursions into the island are described, and one chapter is devoted to the animals of Java and another to the inhabitants,—their language, customs, amusements, etc. On the return journey Dr. Haberlandt spent a few days in Ceylon and finally crossed the Arabian desert in Egypt, already classic ground by reason of the admirable researches of George Volkens on the adaptations of the desert flora.

Not least attractive is the poetic and artistic feeling and the strong personal element that pervades the book. The following are some of the things that attracted special attention: The extent to which variegated leaved plants have been substituted for flowers in tropical landscape gardening; the broken contour of the forest, certain species towering far above the rest and noticeable at a long distance; the general whiteness of the tree trunks; the preponderance of woody growths; the form of branching, in many cases quite unlike that of European trees; the very rapid pushing of leafy shoots which hang down, pale or reddish, weak and limp, until they have reached full size and then gradually become green, erect and self-supporting; the nearly uniform absence of periodicity in leaf fall; the marked tendency of the foliage to be entire, smooth and coriaceous, to which is often added a lacquer-like lustre; the dazzling reflected light of tropical foliage, in striking contrast with the mild transmitted light of European foliage; the numerous modifications of leaves and changes of position to avoid very intense light; the enormous assimilative power of individual leaves and the comparatively small number on a tree; the excessive brightness of the sky and the great amount of light in the interior of a tropical forest, the shade being not nearly so dense as in an European beech wood; the enormous vegetative activity, the sharp struggle for light, and the occupancy in the forest of every available foot of space, an almost impenetrable thicket on the ground, epiphytes and lianas on the trunks of trees in great profusion lifted up out of the surface tangle, and individual trees reaching the necessary light by expanding their tops above the rest of the forest; the general lack of protective adaptations against cold, so that one comes to understand the full meaning of many northern modifications only after he has studied the tropical vegetation; the very rapid growth (in young trees frequently as much as five metres a year), which takes place in an atmosphere so moist that transpiration is greatly diminished or at times stopped altogether, and which goes to show that there is no necessary connection between the transpiration stream and the upward movement of plant foods from the roots, osmotic action being sufficient to bring it about; the noticeable absence of palms from the forest; the curious adaptations to conserve moisture, roots within pitchers, etc.; the occurrence of breathing roots in the swamp plants, *Sonneratia* and *Avicennia*, and of bracing roots in many trees, in *Sterculia* enormously developed; the numerous extra functions of tropical roots, most striking of all "the change of the aërial roots of various Orchideae into green, ribbon-shaped organs of assimilation" (*Tæniophyllum Zollingeri* has no other); the preponderance of bright colors in tropical flowers (white, yellow, orange, and bright red) and the rarity of blue flowers; and, finally, the many leaves, stems, etc., in which a particular form seems to be of no value to the plant but has been retained because not harmful, the hypothesis being put forward that many of these forms, not all, are mere "Luxus Anpassungen," due to the internal energy of the plant, and are not modifications brought about by external agencies, such as food and climatic changes, the author pointing out that the multiplicity of these variations is greatest in the places where, according to the Darwinian law, they should be least, viz., in the tropics, where the climate varies but little,—"Zwecklose Blattgestalten und ebensolche Verzweigungsformen, phantastischsinnlose Blütenmodelle und tausend anderer morphologische Eigenschaften, die nutzlos sind, bleiben erhalten weil ihre Ausmerzung kein unbedingtes Erforderniss für der Fortexistenz der betreffenden Pflanzen war."

This is a volume to go on the shelf with Schimper and Goebel, but not until it has been read and enjoyed from cover to cover.

PARASITIC ALGAE.

One of the most interesting botanical finds during the Madison meeting of the A. A. A. S. was made by Mr.

W. T. Swingle at the Dells of the Wisconsin River, where an endophytic alga was discovered in the leaves of the common Indian turnip (Arisaema triphyllum). This parasite causes white spots, which are often one-half inch or more in diameter and in which the bright green threads of the alga are distinctly visible with a low power objective or even with a good hand lens. From Wille's description and illustrations of Phyllosiphon arisari (in Engler and Prantl Nat. Pflanzenf.) this would seem to be that species. Heretofore it has been known only from the leaves and stems of Arisarum vulgare in southern France and some parts of Italy, being first described by Kühn in 1878.

Another algal parasite, Mycoidea parasitica, was described at the same meeting, having been discovered by Mr. Swingle in Florida, where it forms rusty patches on the leaves of Xanthoxylum. This was first described by Cunningham from the leaves of various tropical land plants and is figured by Wille (l.c.) This plant is also new to the United States, and its discovery, with that of the Phyllosiphon following so close upon its heels, suggests the probability that other of our land plants are parasitized by algae, especially in damp situations, and that many interesting discoveries will be made now that attention has been called to the subject. Mr. Swingle's suggestion that the parasitic phycomycetes, *e.g.*, Peronospora, may have been derived from some such land forms rather than from the water-loving algae, appears to be worth considering. The effect of the Phyllosiphon on the Arisaema leaf suggests a fungus, and it would certainly be considered one but for its chlorophyll.

VEGETABLE FERMENTS.

Mr. J. R. Green in *Annals of Botany* (March, 1893), has a long paper on vegetable ferments, embodying a digest of the present state of our knowledge. "Provisionally," says the author, "these bodies may be classified according to the materials on which they work. We may thus make four well-marked groups, excluding those which are obtainable from micro-organisms, as well as one or two whose action has not been thoroughly investigated. These groups will be: (1) Those which attack carbohydrates. These will include the different varieties of diastase, the ferment transforming inulin, the invertase which breaks up cane-sugar, the cytohydrolysts attacking cellulose, and the ferment which forms vegetable jelly from pectic substances. (2) Those which decompose glucosides, with formation of sugar and various aromatic bodies. Of these the best known are emulsin or synaptase, myrosin, erythrozym, and rhamnase. (3) The proteo-hydrolytic group, including vegetable pepsin, trypsin, and rennet, resembling very closely the animal enzymes bearing the same names. (4) The enzyme that decomposes oils or fats." The common or translocation *diastase* has a wide distribution in plant cells, and Barenetzky suggests that it is universally present so long as the cells are living. It slowly dissolves starch, converting it into sugar. A more active form known as diastase of secretion destroys the starch grain by corrosion. It occurs in various grains but only at the commencement of germination, being apparently secreted by the epithelial cells of the scutellum, but according to Haberlandt by the aleurone layer in the barley grain. *Inulase* occurs in the artichoke, dahlia and various other Compositæ. It first appears in the germinating tubers, converting the inulin into sugar. *Invertase* occurs in a variety of vegetable substances,—yeast, bacteria, fungi, malt, buds and leaves, pollen, grains, etc. It has the power of inverting or hydrolysing cane sugar into dextrose and laevulose. It occurs also in animals. A *cytohydrolytic* ferment probbably occurs in the endosperm cells of palm seeds, but no one has yet been able to isolate it. The author cites De Bary's well-known experiments on the extrusion of a cellulose dissolving substance from the hyphæ of certain Pezizas, and Marshall Ward's on the lily Botrytis, and thinks that such bodies are not exceptional in the vegetable kingdom. Brown and Morris have discovered a similar enzyme in germinating barley grains. *Pectase* occurs in a variety of plants, carrots, beets, fruits, etc., and has the power of converting cellulose into gum. *Emulsin* occurs in certain Prunoideæ in the vicinity of the fibro-vascular bundles. It decomposes amygdalin into sugar, benzoic aldehyde, and prussic acid, and also decomposes many other glucosides. *Myrosin* is the characteristic enzyme of the Cruciferæ, but is probably not confined to this order. It breaks up the very complex glucosides abounding in Cruciferous plants into sugar and certain strong-smelling compounds generally containing sulphur. This enzyme occurs in special cells variously distributed. The strong smell of black mustard seed when bruised and covered with water is due to the liberation of sulphocyanate of allyl from contact of this enzyme with the glucoside, sinigrine, contained in other cells of the seed. *Rhamnase* occurs in the seeds of the Persian berry, Rhamnus infectorius. It decomposes a glucoside, xanthorhamnin, into glucose and a bright yellow dye, rhamnetin, the glucoside occurring abundantly in the pulp of the fruit and in the pericarp. Attention was first drawn to this enzyme by the discovery that decoctions of the pericarp alone would not produce the dye but that it developed at once when mixed with a little of the crushed seed. Subsequently Marshall Ward found out that the enzyme was located in a very small part of the seed, viz., the raphe, and that no other part of it would decompose the glucoside and produce the dye. *Erythrozym* occurs in the madder root, and there are yet other glucoside-enzymes, but less well known. *Pepsin*, or ferments very closely resembling it, and provisionally to be classed with it, occur in Drosera, Dionæa, Pinguicula, and other insectivorous plants. Probably the ferments found in Nepenthes, Sarracenia, and Aethalium sapticum also belong here. They are capable of dissolving proteids, connective tissue, cartilage and gelatine, and are most active in a slightly acid medium, strikingly resembling in these particulars the pepsin of the stomach. *Trypsin*, capable not only of converting proteids into peptone but also of breaking up the latter into amide bodies, occurs in the pawpaw (Carica papaya), the fig, and a melon (Cucumis utillisimus), the natives of India having for a long time made use of this fact by cooking certain fruits with tough meat to make it tender. A similar enzyme exists in the juice of the pineapple, in the seeds of vetch, hemp, flax, barley, castor beans and lupins, at the time of germination. Daccomo and Tommasi have also described a proteo-hydrolytic ferment from Annagallis arvensis, the fresh plant disintegrating fresh meat or fibrin in thirty-six hours when kept in contact with it at 60° C. *Rennet* occurs along with trypsin in commercial papain, in the juice of the pineapple, and in the seed of Ricinus. It has also been extracted in recent years from a variety of seeds, some before and others during germination. Lea has given quite a full account of its preparation from the seeds of Withania coagulans, a Solanaceous shrub of Afghanistan and northern India, and the author has found it in seeds of Datura Stramonium, Pisum sativum, Lupinus hirsutus, etc. It also occurs in the pericarp, pulp, and expressed juice of the ripe fruit of the Naras (Acanthosicyos horrida), a Cucurbitaceous plant of South Africa. The power of curdling milk also exists in the flowers of Galium verum, a plant still used in west England by cheesemakers; in the leaves of Pinguicula vulgaris, first noted by Linnaeus as in use by Lapland tribes for this purpose, and said by Pfeffer to be still used in the Italian Alps; in the glands of Drosera, noted by

Darwin; in the stem of Clematis vitalba; and in the petals of the artichoke. *Fatsplitting enzymes* have been discovered in seeds of Ricinus, rape, opium-poppy, hemp, flax and maize. In the castor bean it is distributed throughout the whole endosperm.

These ferments seem to arise from vegetable zymogens, the existence of which was first established by Vines in experiments on Nepenthes. The constitution of enzymes is still in dispute. Loew, as the result of analyses, considered them to be proteids closely allied to the peptones, but spectrum analysis and other evidence has now made this doubtful. Vegetable ferments are readily destroyed by boiling, and are for the most part very sensitive to acids and alkalies, a slight excess destroying them or stopping all action. They are not readily identified in tissues by use of stains. Some are very unstable. Enzymes have very slight power of diffusion. They can make their way through cell walls, but not through the parchment walls of dializers. They appear to act in an ordinary chemical way, causing hydration (myrosin excepted) and subsequent decomposition. Most of the changes brought about by enzymes can be effected in the laboratory by ordinary chemical processes. They are extracted for experimental purposes by water, salt water, or glycerine, and are quickly precipitated by excess of alcohol. One of their most striking peculiarities is the enormous power of conversion they possess, a sample of invertase being capable of inverting 100,000 times its own weight of cane sugar without injury to itself. The ferments of the fungi and bacteria are also enzymes, and the old view of Naegeli that there are two distinct classes of ferments, organized and unorganized, is no longer tenable. Enzymes have been isolated from a number of bacteria, and even several from the same organism,—in case of the potato bacillus, B. mesentericus vulgatus, no less than five, viz., diastase, invertase, rennet, a proteohydrolytic enzyme and one destroying the middle lamella of vegetable cells.

MAPLES.

In an interesting paper on "Sugar Maples, and Maples in Winter" (Repr. from Fifth Annual Report, Mo. Bot. Garden), Dr. Trelease discusses the synonomy of certain species which has shifted about a good deal of late. He recognizes the western sugar maple as Acer grandidentatum Nuttall; the eastern, as A. saccharum Marshall with two varieties, barbatum (Michx.) Trelease, and nigrum (Michx. f.) Britton; the southern, as A. Floridanum (Chapman) Pax, with variety acuminatum Trelease.

The second part of the paper describes the winter appearance of all our species, the difference in bark, leaf-scars and buds being ample for their determination. The paper is accompanied by sixteen plates illustrating twigs, leaves and fruits. It was written partly for teachers, and it is to be hoped that it may find its way into the hands of a good many. Certainly there are hundreds who have no idea how interesting a study can be made out of bare twigs, and to whom this paper would prove very serviceable.

THE FOSSIL FLORA OF S. E. FRANCE.

In May, 1893, at the Montpellier meeting of the Botanical Society of France, M. Saporta read a paper of twenty pages (recently published in Bull. de la Soc. Bot. d'France) showing the relationships of the living flora of Provence to that found in the rocks, especially of the Aquitanian. In the author's own words, his conclusions are not drawn from simple and vague analogy, nor even from a more or less close morphological similarity, but rather from resemblances so close (*intime*) as to be indications of a genuine filiation. In other words he supposes the living forms in question to be the direct descendants from those whose fragments have been found in a fossil state. Only woody plants are considered, since herbs have left but insignificant vestiges too scanty for throwing any light on problems of descent. As preliminary to this consideration it should be borne in mind, first, that the farther back we go the fewer and the more vague and general are the resemblances of fossil plants to living ones, and, second, that the earliest relationships close enough to be considered filiative are with exotic species, growing generally in more or less restricted areas. Descendants of other early forms still occur in France but often in exceptional conditions of isolation and retreat. In more recent times, *i.e.*, toward the miopliocene, the flora changed gradually, the palms, laurels, magnolias, etc., which had long dominated, giving place to new elements probably derived from the north. These new-comers were principally oaks, of the Robur group, poplars, maples, and lindens. Then only did the vegetation of central and southern Europe begin to resemble its present condition. The most ancient flora considered by M. Saporta is from the gypsum beds of Aix, which belong to the uppermost horizon of the Eocene. They have been explored for twenty years, and about 500 species are known. Fourteen species now indigenous to southern France so closely resemble forms from these beds as to be considered their lineal descendants. These are: Ostrya carpinifolia, Quercus Ilex, Quercus coccifera, Olea Europæa, Fraxinus oxyphylla, Nerium Oleander, Styrax officinale, Hedera Helix, Cornus mas, Paliurus aculeatus, Pistacia Terebinthus, P. Lentiscus, Rhus Coriaria, and Cercis Siliquastrum. Other types occurring in these beds are now represented only by exotic species, *e.g.*, Callitris quadrivalvis in Algeria, Zizyphus spina-Christi in Tunis, Myrsine retusa in the Canaries, Amygdalus communis in Asia minor, and species of Ailanthus and Catalpa in eastern and southern Asia. In the oligocene many additional relationships appear. Notable among these new-comers are the ancestral forms of the California Sequoia, the N. Am. Taxodium, and the Chinese Glyptostrobus. These first appear in England and subsequently in southern France. The greatest interest, however, centres in the Aquitanian flora. From the Manosque beds of this horizon there are no less than thirty ancestral forms of exotic species. These species, although long excluded from France, have varied so little that they cannot be separated from their presumed ancestors. Among them are Sequoia sempervirens in California, Sabal umbraculifera in America, Myrica salicina in Abyssinia, M. sapida in Nepaul, M. Faya in the Canaries, Betula cylindrostachya of interior Asia, Alnus subcordata of the Caucasus, Carpinus viminea of Nepaul, Fagus ferruginea of America, Populus Euphratica of Algeria, Syria and Palestine, Zelkovia crenata of the Caucasus, Z. Protokeoki of Japan, Persea gratissima of the Tropics, Nelumbium speciosum of southern Asia, Magnolia grandiflora of Louisiana, Acer cratægifolium of Japan, Acer rubrum of America, A. rufinerve of Japan and A. sp. of interior China, Berchemia volubilis of America and an unnamed similar species from Yunnan. Among the species which, with slight modifications, have held their own in southern France from the Aquitanian down are the following: Juniperus Oxycedrus, Smilax mauritanica, Alnus incana, Carpinus orientalis, Ostrya carpinifolia, Fagus silvatica (through one or several intermediate forms in the mio-Pliocene), Salix fragilis, Populus nigra, P. alba, P. Tremula, especially Asiatic varieties of the type Tremula, the southern variety of Ulmus montana, Laurus nobilis, Fraxinus oxyphylla, Olea Europæa, Styrax officinale, Acer opulifolium, A. Opulus, A. campestre, Rhamnus frangula, and Cydonia vulgaris. The Aquitanian is still a long way from modern times. In the pre-

dominance of Palmaceæ Lauraceæ, Magnoliaceæ, Cedrelaceæ, Sapindaceæ, and arborescent Leguminosæ; in the presence of such genera as Engelhardtia, Ailanthus, Bauhinia, Lygodium, and Chrysodium; and in the frequency of Cinnamomum, Persea, and species of Myricaceæ, Cesalpineæ, and Mimoseæ we are introduced to a vegetation which is certainly very different from that now existing in southern France, and the contrast would be complete were it not that these types are associated with genera still indigenous, such as Alnus, Betula, Carpinus, Ostrya, Populus, Salix, Ulmus, and Acer. The tropical and sub-tropical types were eliminated during the course of the Pliocene, and the other types became variously modified, as shown by a series of intermediate forms extending from the Aquitanian down to recent Pliocene. Another fact of interest is that the greater number of the European descendants of these ancient floras belong exclusively to the Mediterranean flora, while many occur only in isolated localities and seem to have but a slender hold upon the region. The absence of certain species which form an integral part of the present flora lead to the belief that they appeared later than the period represented by the Aquitanian of Manosque. Toward the mio-Pliocene a new alluvion containing vegetable forms was superposed on the preceding, and this was correlative with a partial elliminaton of species which Europe had possessed until then. Up to and including the Aquitanian there are no vestiges in southeastern France of any of the following types: Alnus glutinosa, Coryllus Avellana, Carpinus betula; the Robur, Toza and Infectoria sections of Quercus; Platanus, Liquidambar and Liriodendron; Ficus carica; Tillia, Carya, and Pterocarya; Ilex aquilifolium, Acer Pseudoplatinus, A. platanoides, Sorbus torminalis. These came in at a later date and in most cases apparently from the north, appearing lower down in formations further to the north. In the Swiss Helvetian there is a Pterocarya which nothing distinguishes from a living species of the Caucasus, and a Liriodendron scarcely distinct from that of America. The Platanus aceroides seems to have followed the same course as the Tertiary tulip tree, both species growing together in mio-Pliocene times in the valley of the Rhone. The last part of the paper is taken up with a critical consideration of the southern European oaks based on a study of material from the mio-Pliocene beds of Italy and France, in which there are species of the following sections of the genus Quercus,—Cerris, Ilex, Toza, Robur, and Infectoria. The paper is accompanied by three lithographic plates and two figures in the text.

THE BOTANICAL LANDSCAPE.

BY J. W. CHICKERING, NATIONAL DEAF-MUTE COLLEGE, WASHINGTON, D. C.

If there be among either the older or the younger botanists of our country any who, in these days, when so much attention is paid to laboratory work, microscopic investigation, discussion of the laws of nomenclature and other theoretical inquiries, still retain interest in field work, and are not afraid of being considered "mere collectors," I should like to suggest one direction in which there is still opportunity for observation and record.

Distributive botany has always had its fair share of attention. We are familiar with the change in the vegetation, as we go from the equator to the poles, or from sea level to the snow line on our loftier mountains. Our catalogues present us with the percentage of change in the flora, as we pass from New England either west or south. But little has been said in either manuals or local catalogues about what might be called the botanical landscape of different localities. By this is meant a recognition of those species occurring so in mass as to give color and character to the whole landscape, even when seen from a carriage or a railway train.

Our ordinary idea of a local flora is the whole number of species detected by the careful and skilled botanist, in the narrow ravine, or underneath the dark shadows of over-hanging cliffs, or over-arching forests. But I wish now to suggest, especially to those who may edit future manuals or local catalogues, the desirability of noting those plants which thus form a conspicuous part of the landscape, and moreover of noting and recording the gradual change of species, as, for instance, among the *Solidagus* and *Asters* in passing from one section to another.

As an example, I will give a few notes of such social and colonizing species as attracted attention during two or three summers in eastern Maine and Nova Scotia. Many of our sub-Alpine plants here descend from the mountains and take possession of the soil near the level of the sea. Notably is this the case with *Empetrum nigrum*, covering the swamps, intermixed with *Ledum latifolium*, and *Rhododendron rhodora*, and in a few localities *Rubus chamaemorus*, the cloud-berry, sufficiently abundant to have its fruit brought to market, under the name of baked-apple, though, according to Mr. Kennan, much inferior in flavor and juiciness to the same species as found so abundantly on the Siberian steppes.

Along the valley of the Cornwallis River, for miles on either side the railroad, are masses of *Corema conradi*, and all through eastern Maine *Vaccinium vitis-idaea* is the most abundant, as it is the most aromatic in flavor of all the cranberries.

In eastern Nova Scotia a European species, *Senecio jacobaeus*, the ragwort, was noticed as replacing and exterminating the native *Solidagos*, and likely to become a troublesome weed, if it holds on its westward way.

In eastern Massachusetts are seen occasionally patches of *Genista tinctoria*, wonderfully brilliant on Salem hills, and less abundantly *Galium verum*.

In some parts of western Massachusetts, *Potentilla fruticosa* is similarly conspicuous, but a most pestilent invader, over-running and ruining hundreds of acres of good pasture land.

Down in the Shenandoah Valley, in Viginia, the traveller's attention is arrested by the great masses of *Echium vulgare*, known as blue thistle, not only diversifying the landscape with its cerulean hue, but supplying honey to millions of bees.

Perhaps the most beautiful sight I ever beheld of this sort, was along the banks of the Carrabasset River, in Maine, where for four miles *Epilobium angustifolium*, one of the many plants known as fire-weed, covered the ground, reaching a height of three or four feet, and rising and falling with every inequality of the surface, suggesting the idea of a fall of pink snow to that depth.

That was on August 14, and on June 8 fire had devastated that section, lasting for some two weeks, apparently destroying all possibility of vitality remaining in any seeds. And yet less than two months after there was this profusion of inflorescence.

Whence did that growth originate? Our driver said that it had never been very abundant in previous years, and that it began to start about three weeks after the fire.

But it is of course the *Asters* and *Solidagos*, with a few other *Compositae*, that in the autumn give color to the landscape almost to the exclusion of all the other species.

In eastern Maine by far the most abundant and conspicuous of these is *Solidago* nemoralis, covering the dry rolling uplands with a yellow carpet of great beauty for mile after mile. Along roadsides partly shaded *S. serotina*, var. *gigantea* is the most common.

In moister ground *S. puberula* prevails, and in the extensive swamps *S. uliginosa* is very abundant, vigorous and beautiful.

This region, especially where it is a little swampy, is the paradise of *Asters*, *A. punicens* being the most abundant and showy. The earliest of all is *A. radula*, which is gradually replaced in southern Massachusetts by *A. spectabilis*, and again in New Jersey by *A. surculosus*. In a few localities *A. Novae Angliae* is very showy and abundant.

In Massachusetts, as autumn approaches, the fields and roadsides are whitened with low, bushy species, which are mainly *A. multiflorus* and *A. vimineus*, which, as we move southward, we find largely replaced by *A. ericoides*.

In the vicinity of Washington, D.C., *Aster tradescanti*, *diffusus*, *patens*, *simplex*, *undulatus*, *paniculatus* and *tenuifolius* are often seen in sufficient quantity to give character to the landscape, which *A. linariifolius* is very abundant, and among the pines *A. concolor* is occasionally found in mass, as is its congener, *A. Curtisin*, among the North Carolina mountains.

Among the golden rods which color extended areas are *Solidago bicolor*, with its var. *concolor*, *erecta*, *arguta*, *rugosa*, *nemoralis*, *Canadensis* and *lancolata*, while *S. sempervirens* is found in mass, bordering salt marshes from Maine to Virginia.

But perhaps this article is already sufficiently extended to call attention to the point desired to be emphasized, and to suggest to botanists the habit of observing and putting down in their note-books those species which by their abundance give color and character to the landscape, and then occasionally sending to scientific journals the results of such observations, so that future editors of manuals and local floras may be able to give some accurate and reliable notes respecting this long neglected department of botanical research.

BOTANY IN THE SCHOOLS.

BY KATHERINE E. GOLDEN, PURDUE UNIVERSITY,

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THERE has been a great deal published in *Science* upon the subject of biology in the colleges, but little or nothing has been said relative to the teaching of the subject in the common schools. This point was impressed upon me more forcibly upon receipt of some school reports. In the reports, which are prepared by the superintendent of instruction mainly for the benefit of the tax-payers, a statement is made in regard to the various subjects taught, and for those subjects not in the ordinary curricula reasons are given showing their desirability for the pupils.

From the fact that reasons are considered necessary, it would seem to imply that the subjects in question are considered not entirely essential, this being especially true of the subjects that come under the heading "nature study," these usually being botany and a very little zoölogy. There is given usually a tabulated statement of the benefits the pupils derive from their study, the tabulated statement consisting in many cases of the pedagogical principles that a normal school student is crammed with before an examination, or that one hears rattled off so glibly at a teachers' institute.

And yet behind the reasoning and the tabulated statement there is usually a dense ignorance of the subjects. For if the subjects were understood, no person of ordinary intelligence would feel called upon to give apologetic reasons, or would expect that teachers without any previous training in those subjects would be competent to teach them. Trained teachers are provided for music, drawing, physical culture, sewing, cooking, and manual training, who, besides teaching the pupils, meet the teachers at stated times to coach them in the work, so that they also may be fitted to help the pupils. But in "nature study" it is not considered necessary to have a special teacher, any ordinary teacher being supposed capable of mastering the subjects embraced under that head.

Here is an extract from one report:—"Truly it is said that this work must be done in such a way that it shall lead to the love of nature. Here the task-master has no place. Only they who can lead in the spirit of the student have the power that will inspire in the children the needed zeal." This reads beautifully from the rhetorical point of view, but in the connection in which it was used it was the veriest rot, for the writer knew that the teachers, being for the most part graduates of his own high school, in which neither botany nor zoölogy was taught, knew nothing of the subjects. The writer closed his statements by saying that elementary botany had been taught the previous year, and that, when directed by a teacher in sympathy with it, always interested the young.

Botany is the favorite "nature study," because the teacher can make selections of such pretty flowers, with beautifully long names. Then the flower can be separated into its constituent parts, and the name of each part learned by the pupils; this same process can be gone over with other flowers, and all on pedagogical principles of the latest date, for is not the pupil using natural objects, and finding out things for himself by an analytic process?

Now, if instead of frittering away the children's time by "object lessons" of the James Whitcomb Riley "peanut" variety, a competent specialist were to be put in charge of the work, one who would have a scheme of work that was consecutive, and who could instruct the teachers, just as the specialist does in music, drawing, etc., a minimum amount of time devoted to the work in school would give good results, besides taking a burden off the shoulders of the teachers. For the public school teachers are much imposed upon in having to teach subjects of this kind for which they are not prepared, and in many cases do not know how to set about making up for the deficiency. A subject of this kind is sprung on them, so to speak, by the superintendent, who sometimes does not realize what its teaching involves.

It is said that the public schools are overburdened with work, and that they cost too much already; well, if that be so, then drop the subject altogether from the curriculum. If this statement as to overburdenment and cost be not true, then the subject should be taught in a proper manner. And to teach it in a proper manner means to pay for a specialist who knows the work and who can direct it properly. Not an "object lesson" specialist, but a botanist. And it cannot be expected in this work that a cheap teacher will do, for nearly invariably a forty-dollar man does forty-dollar work. False economy in teaching always involves more or less waste of time and money.

SOME REMARKABLE HOT SPRINGS AND ASSOCIATED MINERAL DEPOSITS IN COLUSA COUNTY, CALIFORNIA.

BY HAROLD W. FAIRBANKS, BERKELEY, CALIFORNIA.

A GROUP of remarkable mineral springs occurs in the valley of Sulphur Creek, Colusa County, on the eastern slope of the Coast Ranges. This section is formed of Cretaceous shales and sandstones, which to the west, in the higher portion of the range, are replaced by an older basement series.

The Coast Ranges, judged from the standpoint of their economic minerals, are characterized particularly by the presence of large deposits of cinnibar. A little to the west of the locality about to be described the cinnibar deposits are seen clearly to be closely related to volcanic phenomena. Mineral springs of every description are more abundant than in any other portion of California. Lava of late Tertiary age covers much of the country in the vicinity of Clear Lake and southward, and it is probable that the springs date from the close of the volcanic activities.

The famed Sulphur Bank at the eastern end of Clear Lake, where has been mined for many years both cinnibar and sulphur, is perhaps the best known of the interesting phenomena in this volcanic region. Almost unknown, however, is the group of remarkable hot springs and resultant deposits of gold and cinnabar in the Sulphur Creek Mining District. Here gold and cinnabar have been deposited from the same solfataric vent, but, what is the most remarkable, both in commercial quantities. While in most mineral regions, as far as our observations have gone, the deposition of minerals has almost if not quite ceased, here it is still going on, and the most excellent opportunities are presented for the study of such phenomena.

It must not be supposed that the gold deposits of Sulphur Creek are typical of the others of the State, for, indeed, they are not. This is the only locality, as far as I am aware, in which gold is found in veins in Cretaceous rocks in California. As a statement of general application it may be said that the epoch of the formation of quartz veins, and the associated gold deposits, ceased before the deposition of the lowest cretaceous beds; that is, following the great upheaval at the close of the Jurassic. Only locally is there apparent any metamorphism in the Cretaceous. The epoch of the cinnibar deposits is very much later, probably beginning at the close of the great volcanic activities following the Miocene, and in rare instances, as in the case under discussion, continuing up to the present time.

About the town of Sulpher Creek is a group of quicksilver mines, several of which show deposits of the usual character, that is, cinnibar distributed in irregular vein form in a gangue of silicified serpentine. The Manzanita mine lies on the north side of the creek, and it is here that the gold and cinnibar are associated in such an interesting manner. They occur in various places over a hill about half a mile in diameter, and which rises several hundred feet from the valley. It is evident that at some past time the whole hill has been thoroughly permeated by hot mineral waters, and either simultaneously or at different epochs, gold deposits were formed from silicious waters in certain spots, while in others cinnibar with more basic solutions almost changed the character of the original shales and sandstones. Cinnibar in small quantities, and often associated with sulphur, can be found over a large portion of the hill. The distinctly gold quartz veins occur on the western side, where great chambers have been excavated in following the veins. Here are thin seams of black quartz, with which calcite is often associated, frozen to the hard silicified walls (originally shale). It is apparent that the quartz was formed in open cavities, not only from the fact that it is always found firmly attached to the walls, but also that open spaces still remain through the centres of many of the veins. These spaces are lined with beautiful drusy crystals of quartz and are sometimes a foot across. The chambers have been worked out down to the water-line, where the gold was found to be largely contained in iron pyrites. In the outer portion of these quartz veins much bitumen is often found, while the centre is sometimes filled with soft white magnesian and aluminous material.

The Manzanita mine was first located for quicksilver but was subsequently worked for gold. In 1891 preparations were being made to save both the gold and the quicksilver, which in many places are found together. At the foot of the hill on the east, where the original works were located, a hot spring still exists. In one of the older workings near this spot beautiful examples of gold and cinnibar in the same hand specimen were obtained. The hot waters were finally encountered, and work in that direction had to cease. An examination of the whole hill shows a remarkable variation in the occurrence of gold and quicksilver with sulphur and bitumen.

The Monticeto mine lies on the south side of the creek just above the town. Gold has been found here in two sandstone strata a little distance apart and inclosed in shale. The sandstone stands vertical, while the gold occurs in thin horizontal seams of a loose sandy character. The adjoining shales are considerably silicified. The largest sandstone stratum has a width of ten feet and has been mined out for some distance on the ore shoot, which dips at an angle of 30°.

The most interesting of all the mines about Sulphur Creek is the Elgin, situated three miles up the valley from the village. Hot springs, still flowing a large amount of water and highly mineralized, issue from a very steep bluff on the south of the creek. Over much of an area, several hundred feet in extent, the formation consisting originally of argillaceous rocks and sandstone, and possibly some serpentine, has been almost completely replaced by silicious and calcareous sinter. The mine is opened by two tunnels, the lower one nearly four hundred feet above the base of the hill, and the upper less than a hundred feet higher up. The lower tunnel has been run in about one hundred and eighty feet with branches and cross-cuts. As one enters, heated air, saturated with moisture and sulphurous vapors, is at once encountered, and all surplus clothing is dispensed with. When well within the tunnel the air grows hotter and more stifling, but one is well repaid by the sights which open to his gaze, and by the feeling that he is witnessing nature at work in her laboratory in a manner which is seldom open to man. The hill seems to have been fissured in every direction. Through these fissures poured mineral waters, once much more abundant than at present, partly or completely filling the cavities and largely replacing their walls by silicious and calcareous deposits. The tunnel seems almost lined with beautifully banded aragonite mixed with silicious sinter of different kinds, varying in color from black to white, and in texture from porous to compact. Much of it is almost glassy and opalescent. Distinctly crystallized silica or quartz is rare. Here and there great cavities stretch away and downward farther than one can see, being completely lined with sparkling crystals of calcite, or stalictitic forms often grouped and branching like huge corals. One mass was observed nearly two feet in diameter, quite spherical, and entirely surrounded by radial stalactites four to five inches long. At the limit of one of the workings water of almost boiling

temperature was encountered. The heat and sulphurous vapors are almost stifling. Here it is that mineral deposition is still going on. Most noticeable is it in the case of sulphur, minute sparkling crystals of which line the cavities. Not only are cinnibar and sulphur present but gold also in small amount. In the lower tunnel a brown bitumen is abundant in the rock cavities. It results from the vaporization of bituminous matter in the deeper seated portions of these cretaceous rocks. The cinnibar for which the mine is being developed occurs impregnating the silicious sinter and aragonite, evidently having been formed with them. In exploring the deeper and hotter portions of this mine but little stretch of the imagination is needed to picture oneself within the very bowels of the earth.

In the upper tunnel is well illustrated the cooler conditions requisite for the deposition of sulphur. While in the lower tunnel it is found in comparatively small amount, in the upper the rock is richly impregnated with sulphur crystals. The cavities of the brecciated sinter fairly sparkle with them.

On the north extension of the Elgin, sulphur works have been opened for the mining of sulphur, which exists mixed with soft friable tufas of a variable appearance and composition.

A careful study of the Elgin mine would be a means of making one familiar with the formation of sulphur and cinnibar in the coast ranges. While the conditions are of course not all alike, the springs varying in temperature and composition, the manner of deposition is everywhere much the same for these minerals.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as a proof of good faith.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The Editor will be glad to publish any queries consonant with the character of the journal.

The Data of Bird Flight.

In *Science* for Jan. 26, 1894, p. 46, Mr. C. F. Amery, commenting on Professor Langley's recent "Internal Work of the Wind," makes inroads into what had seemed to be the fund of accepted observational data in regard to bird flight—soaring flight in particular. Possibly there is not to be found in print any deliberate and detailed summary of the bare, unexplained, facts of the bird's performance, upon which there is agreement among recent students of the subject, but a considerable list of accordant observations may readily be made up from the several notable papers of the last few years, which have dealt with the general problem from a new experimental point of view. The interested public is aware that the whole matter of air-navigation has of late been taken up *de novo*, by searching inductive methods, and it is fairly to be inferred that renewed observation of soaring birds, in connection therewith, has been more orderly and appreciative of essentials, hence more definite and trustworthy. It is, therefore, disconcerting to the non-specialist to find seemingly fundamental data of the investigation discredited.

Mr. Amery affirms, in effect, that the soaring bird cannot keep up to a level course in straight onward flight, whatever the motion, bodily or differential, of the air through which it passes; that it is by circling that altitude is maintained or gained. Yet it is a matter of frequent comment in regard to the sailing flight of certain sea birds, notably the "wandering" albatross, that they perform just this feat. Circling is the persistent habit of the soaring land birds, of which, among many competitors, the eastern vulture is perhaps past-master for varied skill; and there is conspicuous suggestion of a cause-and-effect relation in sustained circle-soaring. But the sea bird travels a wider field, and more commonly sails a straight course; moreover, its normal plane of flight is not at high altitudes, but within the possible vertical range of the sea-going observer, whose interest, furthermore, the bird reciprocates—in fact, if not in kind—so that its performance is brought into notice at short range. And the burden of testimony is that, in air conditions ranging between extremes of storm and calm, the albatross and other sea birds do, in fact, for long distances, travel the wind on undeviating courses, in virtually effortless flight. It has been my opinion that this paradoxical statement was yet a statement of fact, and that it was only the diverse explanations of this and other similarly puzzling phenomena that were in controversy.

For several years I have been an attentive observer of soaring birds, but my incentive has been limited to the interest of verification for myself of what were believed to be the accepted data of the modern investigation. Mr. Amery's dictum puts us (or at least myself) all the more into disorder because there is seemingly no recognition that, from such a postulate, we must undermine a body of doctrine.

If, perhaps, it is I, as a non-specialist in the audience, who am the one in fault, then there is compensation in the added value my verification-notes will have acquired, as contributions to a question still open. On that contingency I draw upon them here.

The best representatives of the air-sailers, among sea and land birds respectively, of which I have had opportunity for close observation, have been the remarkably tame gulls of San Francisco Bay, and the hawks of the Rocky Mountain region. The gulls are tamed by the ferry passengers, who feed them with crumbs, to be caught on the wing. They follow alongside, a little beyond arm's length. In a wind of moderate strength (I am not able to speak with certainty about directions) they will for some minutes maintain, without wing stroke, fixed positions, with reference to the boat, as steadily as though perched on the rail. In review of the lines of spectators, they abruptly drift forward and backward, and rise and sink between deck levels. As with flies in the air of a railroad car, the general forward course appears to be no matter of their concern. These subordinate motions are all in the vertical plane of the general forward motion—parallel to the boat's side, just beyond cane and umbrella reach. To the vertical plane, the line of the wings is held unvaryingly at right angles. Upon this steady horizontal axis there is, however, rotation at the shoulder; but barely perceptible in amount, and quick, with momentary pauses, discontinuous, and unrythmical—apparently an exceedingly alert and vigilant balancing process. The tail is slightly and slowly opened and closed, fanlike; and slightly, but quickly, tilted sideways, and up and down. The head is moved deliberately, in all directions, with the effect of a quiet glance, independent of the general nervous activity. At an increased distance, as with the leaning ship that has carried the roar of the wind in its sails beyond hearing, only the easy poise is noted. Occasionally a gull will venture to alight on the pilot house. He wheels into position, and, the feet hanging downward, connection is made through the last inch or two carefully, as in train-coupling with both sections in motion; but the wings remain fully extended until the body is at rest, when they are folded in gently, as though pains must be taken to avoid again catching the wind. If startled from his perch, he makes a strong wing stroke, and slants swiftly backward and downward; but the usual mode is a repetition, in reverse, of the alighting process: without the initial impulse of a stoop and spring, he floats outward and upward, ahead of the boat; then, perhaps, circles into place

alongside. In dead calm, few birds leave the ferry slips for the trip, and these labor heavily across in flapping procession.

From observation of land birds I have but one note of interest. It relates to the repeatedly observed feat of a small hawk. In this instance there is no advance in any direction. Like the humming-bird he stands poised, without visible support, at a point in space; but his outspread wings and tail are as steadily held as if wired into place by the taxidermist. He points straight into the wind. If he utilizes its shifting "internal forces," he draws upon them, with extraordinary expertness, for a constantly recompounded resultant, to be maintained equal, and vertically opposed, to the pull of gravity. With almost the suddenness of the humming-bird, he will dart from one fixed position to another, seemingly by expenditure of will power only. I believe that it is high winds alone that afford him this sport, or opportunity. And I have never seen him thus poised over level ground, but among hills, even with their summits, and from one to another, close in their lee, like the humming-bird, again, in a garden. On two occasions I have had a fine chance at this skilled aeronaut, from surveying stations on hill tops. I have been able to keep him for several minutes on the cross-hairs of my telescope. As with the sailing gull, there is the same calm eye and the same quick and delicate teetering of the wings; but the individual feathers, excepting at their strongly up-bent tips, exhibit no blur of continuous motion.

If my opinion in regard to such observations as these be correct, Mr. Amery's assertion is disproved, and belongs to a stage of the investigation beyond which we have advanced. WILLARD D. JOHNSON.

Le Droit Park, Washington, D. C.

The Mining Building at Chicago.

To what Mr. G. L. English so well says in *Science* of Feb. 16, in defence of the gallery exhibits against the slurs of the anonymous article in *Science* of Feb. 2, on "The Columbian and the Centennial Expositions," I wish to add a word for the "ground floor." Much of the fault found by the writer of the article in question was deserved, but if he had looked for points of merit as well as of demerit he would readily have found them. The exhibit of New South Wales was wonderful for its extent, variety and completeness. It was a strictly economic display but not without scientific features as well. Everything in it was plainly numbered and labeled, and full descriptive catalogues with corresponding numbers were to be had freely on application. The Canadian Geological Survey made a very complete display of rocks, minerals and ores, in which specimens and groups were carefully arranged and plainly labeled, but the Canadians made an excellent showing at the Centennial and might therefore have been excluded from the comparison by this anonymous correspondent. Pennsylvania, New York and Michigan made displays of their great specialties of production, which were well mounted and cased where necessary and were plainly labeled. New York's geological obelisk was certainly of greater educational than technical value, while the needle of Pennsylvania anthracite coal representing the exact section of a single bed was instructive as well as impressive. North Carolina, New Jersey and Missouri aimed to have their exhibits of direct educational and scientific as well as economic value. New Jersey took especial pains to have her ores, minerals, clays and marls distinctly labeled and to put the labels where they could not be overlooked, while a complete series of the geological maps of the State adorned the walls of the space assigned to her. The Missouri exhibit was labeled with the common as well as the scientific name and the chemical composition of each group of minerals or ores represented, in addition to the printed and written labels on each specimen. About 75 framed maps, charts, diagrams and photographs were displayed in this exhibit each of which bore an adequately descriptive label. The "great piles" of ore and metal here had a definite meaning, which was plainly stated on a large label prominently placed. I might go on and mention many points of excellence in other exhibits on the ground floor, without going into details as to the instructive array of mining, milling and quarrying machinery on exhibition, but I have said enough to show that there were more than "one or two" exceptions to this correspondent's strictures. The general public seemsd, indeed, to care more for the Ada Rehan statue than it did for education in mining, mineralogy, or geology, but that is not the fault of the exhibitors who strove to instruct as well as to interest those who strayed into their spaces in the Mining Building, and I quite agree with Mr. English in thinking that the mining exhibit at Chicago far exceeded that at Philadelphia in every respect, though of course any one at all versed in the matter could detect many defects which might have been remedied. E. O. HOVEY.

New York, March 1.

Petrified Eyes.

IN *Science* of Feb. 2 Mr. Geo. G. Groff, under the title of "Petrified Eyes," calls attention to a statement in some popular school geology that "huge saucer eyes," of a thirty-foot monster, were so perfectly petrified that the "lenses have been split off and used as magnifiers."

About a hundred years ago some students of Palæontology, at Heidelberg, made to represent fossils, out of clay, spiders in their webs, snails with antennæ perfectly preserved, a plump mouse, and other similar things, and left them where they could be found on class excursions. The professor described and pictured them in a book as remarkable fossils. On a latter excursion he found his name fossilized. He gradually realized that he had been hoaxed, and chagrin hastened his death.

Ever since then it has been established that only chitinous, horny, or bony parts of an animal are petrified; soft parts are never petrified. They may leave impressions in a fine soft mud, as the examples of jelly-fish in the Solenhofen—Bavaria—stone so well show. The outlines of the body of worms, fish, reptiles, mammals, are preserved by the shaping of the mud in which they were deposited—not by the membranes themselves being chemically replaced. This is true even of the tougher membranes of the body, as for instance the hide, and much more so with any part as delicate as the crystalline lense. The ease with which the lense is destroyed is shown by one of the three methods employed in treating *cataract* of the eye, where by means of needles the lense is broken up and is finally absorbed by the fluid in the anterior of the eyeball.

Quarrymen seem to delight in finding "fossil eyes," as they name many things from the teeth of *Gyrodus* to quartz boulders.

While the lense could not be petrified, the bony eye cavity, or the cavity formed by the sclerotic ring possessed by many fishes and reptiles (*e.g.*, *Portheus*, *Ichthyosaurus*) could be filled with gypsum, calcite, or quartz in such a manner as to furnish a plano-convex lense.

A. R. CROOK.

Northwestern University, Evanston, Ill.

BOOK REVIEWS.

Economic Geology of the United States; with briefer mention of foreign mineral products. By RALPH S. TARR, B.S., F.G.S.A., Assistant Professor of Geology at Cornell University. New York, Macmillan & Co., 1894, 509 p., 27 figs., 2 plates.

PROFESSOR TARR prepared this treatise to accompany his lectures on economic geology. In the preface he states that foreign localities have been referred to only where their importance or their bearing on the genesis of materials is noteworthy. The matter has been largely compiled. The author has himself studied in connection with official surveys many different areas in the United States, and one can see that he has brought much of his field observation to bear upon the treatment of his subject. The book deals with common rock and vein-forming minerals; rocks of the earth's crust, which are illustrated by an abstract of the admirable tabulation of igneous rocks made by F. D. Adams on the basis of Rosenbusch's system; physical geography and geology of the United States; origin of ore deposits; mining terms and methods; metalliferous deposits; non-metallic mineral products, including coal, petroleum, natural gas and asphaltum, building stones and cements, soils, clays, fertilizers, artesian wells and mineral waters, precious stones, abrasive materials, salt, miscellaneous minerals and general summary of mineral production.

The need of a hand-book of the economic geology of the United States has long been felt, and the works by Kemp and Lakes on ore deposits published in 1893 but partially covered the field which Professor Tarr has traversed in his generally lucid and engaging style. It is a drawback to a treatise on this subject that so far as it depends upon the merits of its tabulated statistics and of its description of existing processes in the arts of mining and manufacture, so sure is it shortly, with the rapid improvement and alteration in mechanical devices, to be discarded as out of date. While Professor Tarr has brought the statistics of production down to so late a date as the year 1892, the scope of the work and the method of treatment will recommend it for use as a text-book for undergraduate collegians long after its statistical information has ceased to be of practical utility. The real problems of economical geology, so far as they are distinct from those of geology proper, must usually be solved by the capitalist and producer. They are such questions as concern the relations of products and by-products, proximity to fuel, fluxes and markets, and are of themselves ever variable in their relations, though tolerably fixed in principle. While this side of the subject is generally least familiar to the geologist, and while our author makes no pretense in his headlines of discussing it, the student will find these important considerations have not been overlooked in the treatment of particular products.

The classification of ores used makes origin of primary and form of secondary significance. The detailed information which follows appears to fall clearly and easily into the groups formed upon this basis.

The local geologist will note some unimportant mistakes, which have doubtless been perpetuated through compilation. Thus it is stated that a few thousand tons of coal are annually produced from the New England coal basin, a statement which was true several years ago. By a slip of the pen, on p. 124, the author makes the "Huronian a division of the Archæan," instead of the Algonkian, as it is given in the table on p. 47. These errata may be readily corrected in a second edition. The press-work is of high order; there is a copious index and an appendix of useful reference books.

An Introduction to the Study of Petrology. By FREDERICK H. HATCH, Ph.D., F.G.S. London, Swan, Sonnenschein and Co.; New York, Macmillan and Co., 2nd edit., ill., 128 p., 90 cts.

THOUGH not new in point of publication, this small work, now in its second edition, continues to be the only elementary treatise on petrology in our language. It is not intended for children but for those older students who may be entering upon the microscopic study of rocks, or for those workers in other fields who may wish to understand something of the manner and methods of modern research in lithology. The book is well illustrated with cuts, drawn in many instances from the works of Rosenbusch, Fouqué and Lévy, Bonney, and Teall.

The Technique of Post-mortem Examination. By LUDWIG HEKTOEN, M.D. Chicago, Ill., W. T. Keener Co.

IN this little book of 170 pages Dr. Hektoen has supplied a lack in our literature. Here are given careful directions for ordinary post-mortem study, describing in detail necessary instruments, general methods of procedure, general points to be noted and the proper methods of keeping data. The book is illustrated with forty-one figures, and is excellently designed for the purpose of guiding the inexperienced physician in making autopsies to the best advantage, obtaining the greatest results therefrom, and keeping his records in the most satisfactory manner.

Le Cuivre. Par Paul Weiss, Ingénieur au Corps des Mines. Paris, Librairie J. B. Baillière et Fils. 1894, 96 figs., 344 p. Cartonné 5f.

IN this volume M. Weiss has presented a very useful work on copper, designed not particularly for specialists, but rather for engineers and others who desire a clear general understanding of the metal, either from the standpoint of its position in economic geology, its chemistry, or its metallurgy. The work is divided into three parts, the first of which treats, in brief but sufficient detail, of the origin of copper and of its ores, of its physical properties and of its alloys. The second part treats of the metallurgy from the roasting of the ore to the refining of the last malte, including descriptions of the Bessemer copper process and of electro-refining. Part third describes the applications of copper, the market, the employment of the metal in electricity and finally the copper foundry and the manufacture of alloys, bronzes and brass. In this connection are given several reproductions of photographs showing the well-known works of M. Weiller at Angoulême. Tables of tensile strength, limit of elasticity, etc., for the various alloys, complete the volume. In treating of the origin and formation of the ores of copper the author, naturally, may be, but with reason, rejects the exclusive lateral secretion theory, as advocated particularly by some German authors, in favor of a fumerole action contemporaneous with the solidification of the basic rocks, the final position of the mineral, or metal, however, being determined by the action of circulating waters. The chapter on the molecular structure of copper alloys, being principally the experiments of M. Guillemin, is one of the most interesting. The examination under the microscope, after etching a polished surface with an appropriate reagent, shows remarkable difference in molecular structure corresponding with differences in chemical composition. Some thirteen micro-photographs are reproduced in illustration of the text, and it may be added that throughout the book is most excellently illustrated and is thus given a decidedly increased value to the general reader.

The Fauna of the Deep Sea. By SIDNEY J. HICKSON, M.A. New York, D. Appleton & Co. Modern Science Series.

THIS volume of the Modern Science Series is one of the attempts at popularizing a subject which is of exceptional interest to scientific readers. The publication of the various deep sea exploring expeditions are too detailed and too technical for the comprehension of the ordinary reader. In this little book of 170 pages Mr. Hickson has attempted to collect all of the essential and interesting results of the study of the fauna of the bottom of the ocean. He gives us a short history of the investigations and describes the conditions of life at the bottom of the sea. The laws of distribution of fauna in different zones of the depths are explained, and then follows an outline of the discoveries in regard to each group of animals as they exist at the bottom of our deep seas. As a popular account of an interesting scientific subject this little volume is successful, and will enable a general reader to answer the most commonly asked questions as to the conditions of life at the bottom of the sea. It is illustrated with twenty-three figures.

Physiological Practicums. By Prof. B. G. WILDER. Press of the *Ithaca Journal.*

UNDER this title Professor Wilder has published as a series of separate slips the directions for labratory work which he furnishes his students in Cornell as guides in the study of mammalian anatomy. Accompanying the laboratory directions are a series of twenty-nine figures on separate slips of paper. From these notes one can gain an adequate knowledge of the method of laboratory work pursued in Cornell, and an instructor who has similar work to do will find the notes of practical value. Exactly why Professor Wilder calls them physiological practicums does not appear, for there is no physiology involved in the work. The practicums cover nothing but general anatomy of certain of the organs of mammals, and any teacher who obtains them with the hope of getting assistance in practical physiology will be disappointed. The practicums, of course, bristle with Professor Wilder's peculiar terminology, a matter not to be deplored perhaps except in the case of the brain. It does seem to be superfluous to introduce here an entirely new set of terms which will be of no value to the student outside of the special text books published by Professor Wilder.

Darwiniana Essays. By Prof. H. HUXLEY. New York, D. Appleton & Co.

ASIDE from Mr. Darwin himself there is certainly no writer who has contributed so much to the general extension and acceptance of the evolutionary doctrine as Professor Huxley. From the first appearance of the origin of the species Professor Huxley has been its champion, and from time to time his clear brain and lucid pen have given to the public essays upon one and another phase of the general studies inaugurated by Darwin. These essays have appeared at intervals from 1859 until 1888, the last one constituting an obituary on Mr. Darwin. The essays scattered in various publications have been finally collected in one little volume, and to them have been added a series of six lectures upon the general subject of the causes and phenomena of organic matter delivered to working men in 1863. Taken together the essays comprise Mr. Huxley's valuable contributions to the general subject of evolution, and one can clearly discern in reading them one after the other the strong influence their author has had upon this growing conception of science. There

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is no need of extended notice of the separate essays, which are so well known to scientists, but their publication together, assisted by the preface, tells us that as a unit they still represent Mr. Huxley's views upon evolution and that he has in later years not swerved to any great extent from the position adopted even in the first essay. This collection of essays of Darwinian hypothesis certainly forms a valuable addition to one's library on evolutionary topics. The title is unfortunate, for Professor Huxley has chosen the same title which has been earlier used by Professor Gray for a similar book, and two books with the same title are sure to produce confusion.

Guide to the Study of Common Plants. An Introduction to Botany. By VOLNEY M. SPALDING, Professor of Botany in the University of Michigan. Boston, D. C. Heath and Co., 246 p., 1884, 85 cts.

THIS little book will doubtless prove of great assistance to many teachers of botany in the elementary classes. The author has given an admirable series of exercises, developing a natural and practicable method in the elementary study of plants and plant life. The publication has been suggested by the frequent inquiries of teachers regarding the preparation in botany required for admission to the University of Michigan.

Summer Birds of Green County, Pa. By WARREN JACOBS. Waynesburg, Pa., Republican Book and Job Office.

Bird Life in Labrador. By WINFRED A. STEARNS. Amherst, Mass. $1.

THE first of these is a brief pamphlet giving a list of the summer birds of Green County, with a note or two as to their habits.

The second is a somewhat more extended account of the birds of Labrador and takes partly the form of a narrative of Mr. Stearns's journey in that country. It contains no descriptions of the birds but more in regard to their habits and abundance.

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CONTENTS.

CURRENT NOTES ON ANTHROPOLOGY. No. XLI. Edited by D. G. Brinton 127

WHAT IS ARCHÆAN? Alfred C. Lane 128

THE PROGRESS OF ASTRONOMY IN 1893. George A. Hill 129

SUNSPOTS AND METEOROLOGY. H. A. Hazen . . 131

AUTUMN COLORING OF LEAVES. G. W. McCluer . 133

THE SPOKEN LANGUAGE OF BOTANY. C. Michener 135

LETTERS TO THE EDITOR:

THE LING ON THE PACIFIC SLOPE. Carl H. Eigenmann 136

THE NATIVE CALENDAR OF CENTRAL AMERICA AND MEXICO. Cyrus Thomas. 136

BOOK REVIEWS 136

NOTES AND NEWS 138

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PROTECTION FROM LIGHTNING.

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Knowing that the energy just before the flash exists in the column of air between the cloud and the earth, which column is indicated in the figure by the dotted lines, and that when the air "breaks down" and the flash comes this energy manifests itself mainly as heat along the central core of this column in what we call a flash of lightning, is it not evident that the energy must be transmitted in lines perpendicular to the lines of electrical stress, *i.e.*, in the main horizontally, indicated in the figure by the arrows?

From all this, which is a part of our current knowledge, it appears that the problem of protection from lightning is a problem in the dissipation of energy; that the energy to be dissipated, while we know it to be considerable, as broken masonry testifies, is but a small part of the whole involved in a flash of lightning, by far the larger part being dissipated as heat above the roofs of our houses. If the conditions can be so arranged, by the use of considerable masses of metal suitably placed, that there shall be no state of stress below the roof of the house, then there will be no energy to be dissipated below that level, and all will go well. But it is surely time that the problem of protecting buildings from lightning should be looked upon as one in energetics and that it should be appreciated that the energy present cannot be hocus-pocussed out of the way but must be dissipated in some harmless manner.

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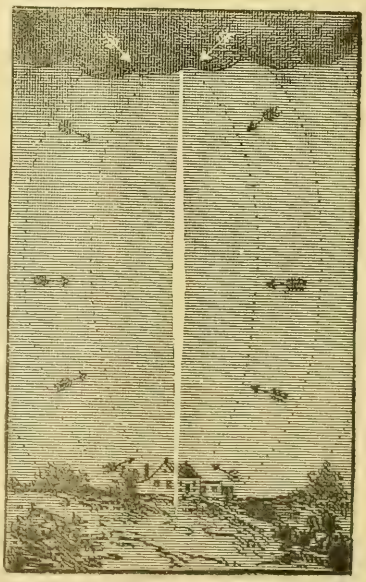

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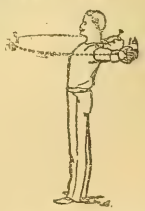

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SCIENCE

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CURRENT NOTES ON ANTHROPOLOGY. NO. XLI.

(*Edited by D. G. Brinton, M.D., LL. D., D. Sc.*)

THE HIEROGLYPHS OF EASTER ISLAND.

In a previous note (see *Science*, May 8, 1892) I have referred to the curious carved hieroglyphs which the Easter Islanders were accustomed to preserve on batons or narrow tablets. The art is lost, and few of the batons remain, as the present generation burnt up most of them for firewood! A genuine one would now be worth its weight in gold—or, at least, in silver. The last and best work on the translation of the inscriptions has lately been published from the posthumous papers of Bishop Tepano Jaussen, apostolic vicar of Tahiti, who included in his diocese Easter Island also. He secured a few of the tablets, and some intelligent natives read them for him, explaining the meaning of each hieroglyph. These he collated, and they are printed in dictionary form, analyzed as far as possible. They prove to be ideographic in character, and are read *boustrophedon*.

The Bishop took much pains to discover the origin of this writing, sending specimens of it widely over Oceanica for comparison. He finally decided that it was brought "more than a thousand years ago" from the Moluccas and the Spice Islands, almost an identical writing having been discovered on ancient stone monuments in the island of Celebes by Archbishop Claessens, of Batavia.

This excellent study of Jaussen's is a pamphlet of 32 pages, entitled "L'Île de Paques," and may be had of Ernest Leroux, 28 Rue Bonaparte, Paris. It is indispensable for every student of the subject.

PALÆOLITHIC VERSUS NEOLITHIC.

In the Journal of the Anthropological Institute for February an important article appears from the pen of Prof. Boyd Dawkins, entitled "On the Relation of the Palæolithic to the Neolithic Period." His main point is to prove that nowhere in the Old or New World can we trace the transition in culture between these two periods. Everywhere there seems a gap or hiatus, sharply dividing the two, this break extending also to the fauna of the two epochs.

This opinion was long ago maintained by Mortillet and other eminent archæologists, but has lately been denied by J. Allen Brown and others. Professor Dawkins makes a strong plea for its correctness; but, after all, his argument has the weakness inherent in reasoning *ab ignorantia*. The most he can show is that *not yet* have the steps of the continuity of the periods been demonstrated; while it would surely be difficult for one familiar with the diligent studies of investigators not to be convinced that there is no such sharp line between the two cultures as was once laid down. For instance, all must now concede that palæolithic man made pottery, which was long denied him.

An interesting part of Professor Dawkins's article is that on the so-called palæolithic implements from the Trenton gravels, New Jersey. He has visited that locality himself and collected some of the specimens of which he speaks. His conclusion is, that there is no sufficient evidence for considering any of the Trenton finds as palæolithic; and that the theories which have been built upon them by their finders will have to be discarded. Evidence of another kind than the mere rude form of implements is needed to determine the presence of palæolithic man in America.

THE SO-CALLED "CRIMINAL TYPE."

The all-important question among criminologists is, whether there is a peculiar physical type, which at once marks and condems the habitual criminal. Reference has already been made in these notes to the wide difference of opinion on this subject which obtained at the last International Congress of Criminal Anthropology (see *Science*, Nov. 18, 1892). In a paper read before the Russian Anthropological Society last October, Prof. E. Petri, of St. Petersburg, declared in favor of the reality of the "type," maintaining that it had been denied because of lack of uniformity in modes of measurement, and in the technical nomenclature, as well as from a neglect of proper selection of cases. He argued that a so-called "pure series" of criminal types could be obtained, and would always show clearly defined contrasts to a series of non-criminal individuals.

On the other hand, the legal profession almost unanimously deny the existence of the "type." Take, they say, a dozen criminals as they come into the dock, wash and dress them as neatly, and they will certainly look as well as the dozen men in the jury box impanelled to pronounce upon their misdeeds. To be sure, many criminals are such through want, misery and destitution, and these leave their traces; but as many more have not suffered in this manner; and a large class of crimes demand a well-regulated life for their commission; so the average is maintained. Of course, exception must be made in either case, of mental alienation, idiocy, insanity and the like.

THE PLEIADES IN EARLY ASTRONOMY.

The prominent position which the group of the Pleiades occupies in many early myths and calendars has recently attracted the attention of several writers. Prof. Norman Lockyer, in his "Dawn of Astronomy," shows that the oldest temple on the Acropolis of Athens was oriented to observe the rising of the Pleiades about the year 1530 B.C.; thus connecting the worship of these stars with the primitive religion of the Hellenes.

The subject has been considered at length and with much thoroughness by Dr. Richard Andree, in a late number of Globus (Bd. 64, No. 22). He analyzes the names of the constellation in many languages, and explains its relation in primitive peoples to their calendars and agricultural procedures. He shows that among the most diverse races and in all parts of the globe, these stars have been chosen either to indicate the beginning of years or cycles, or to regulate festivals and recurrent ceremonies.

One who has also given fruitful attention to this question is Mr. R. G. Haliburton, whose results, many of them not yet published, are spoken of by Dr. J. C. Hamilton in the last (fifth) Report of the Canadian Institute of Toronto. He brings together a mass of curious information concerning primitive beliefs about these stars.

The question has special interest in American archæology. At the Anthropological Congress in Chicago last summer, Mrs. Zelia Nuttall read a paper in which she referred to the well-known fact that by these stars the Aztecs regulated their cycle of 52 years. If they had commenced their computation when at that season the Pleiades culminated at midnight, it would be about 4000 years ago,—a deduction which gives rise to interesting speculations.

WHAT IS ARCHÆAN?

BY ALFRED C. LANE, HOUGHTON, L. S., MICHIGAN.

WHEN in the issue of the *Nation* for March 1, 1894, p. 163, I saw my friend Professor Tarr criticised for calling the Huronian Archæan, and saw the reviewer go on to state that the rocks in which magnetic iron ores mostly occur are not undoubted Archæan, I said, "This is *too* much."

The history of the words Azoic and Archæan shows the irony of fate in scientific usage so well as to be worthy the attention of the readers of *Science*.

The term Azoic was originally applied to all the pre-Silurian strata, at first including the intrusives.[1] Later Foster and Whitney excluded them and applied the term to the metamorphic group or formation,[2]—composed of "Gneiss, Mica and Hornblende Slate, Chlorite, Talcose and Argillaceous Slate, and Beds of Quartz and Saccharoidal Marble,"—supposed to be the first detrital rocks, modified by heat. They expressly mention the association of magnetic iron ores with them,[3] and give Logan's division into two groups, which they say they failed to recognize on the south shore of Lake Superior.[4] The Azoic rocks included all rocks below the Potsdam,[5] existing as a geologic system in the Lake Superior region.

Dana objected to the application of the term Azoic,[6] as a misnomer, since there are direct and indirect traces of life in the rocks to which it was applied, and proposed the term Archæan instead. In his use of the term, Archæan is a name applied to one of the four or five primary divisions of geologic time, co-ordinate with the term Palæozoic. In this he has been followed by Geikie and Leconte. From the text-books of these three men, probably ninety-nine per cent of living American geologists have been taught. Moreover, Dana retained the term Azoic,[7] applying it to the earlier part of the Archæan time, and to the latter part applying the term Eozoic in his manual of geology, Archæozoic in a paper published in 1892.[8]

The arrangement in Dana's text-book seemed an admirable one, was widely adopted, and all seemed serene, when trouble arose. The first symptom of it appeared in a circular letter of the Director of the United States Geological Survey, wherein he suggested the division of Geologic time into *ten* periods, to which provisional names were given.[9] The name Archæan was applied to a period below the Cambrian, co-ordinate with it, and separated from it by another period.

No comment nor notice was made on this degradation of the rank of the word, and of course in a provisional scheme it was not necessary. But when in pursuance of this letter the name Archæan was formally applied to a time division earlier than the time of deposition of the clastic rocks older than the Cambrian, and co-ordinate with Cambrian,[10] the mischief was done.

The term Archæan, introduced to replace Azoic as a misnomer, has been so changed in application by the United States Geological Survey as to include only rocks which cannot but be Azoic.

There certainly could have been no life before the beginning of sedimentation.

The only reason for this change, that I know of, is given by Van Hise in the following words:[11]

"As here used the term Archæan is restricted to this fundamental complex. It is no longer possible to regard as a unit or treat together all pre-Cambrian rocks. The rocks included in the fundamental complex are everywhere called Azoic or Archæan. The crystallines and semi-crystallines above this complex, often called Archæan, must be distributed from the Devonian or later to the pre-Cambrian. It is clear that if Archæan is to remain a serviceable term it must be restricted to some unit. Such a unit is the fundamental complex, and to it this term is most appropriate."

Comment is hardly needful, in view of the fact that for some four hundred and seventy eight pages Professor Van Hise has been treating all the pre-Cambrian rocks together, and that, as he avers, "it is impossible to make a wholly satisfactory theoretical definition of the Archæan" (as he uses it).

I should perhaps add that while I still think that the Archæan will "remain a serviceable term," if retained in the sense in which it was proposed, and is used by all the leading text-books, not only in America, but also in England (Geikie), and Germany (Credner and Neumayr) and is employed by the Neues Jahrbuch für Mineralogie, Geologie, etc. (as one of four or five divisions of geologic time co-ordinate with Palæozoic), I do not here question the appropriateness of its division, nor attempt to combat the arguments so ably urged by Van Hise[12] for the crustal or sub-crustal character of the fundamental complex. I merely cannot see why the time-division given by Dana is not satisfactory, and why the time previous to the formation of clastics should not be called Azoic. Then for a parallel formation term, according to the principles of that dual nomenclature, rightly proposed by H. S. Williams, Van Hise's term Basement Complex seems to me very appropriate. Possibly Basal, as somewhat shorter, and in adjectival form more correspondent with other terms, might be better. The age of the Basal, so far as formed by subcrustal consolidation, might not be altogether Azoic, but it would all belong to one formation.

[1] Van Hise, Archæan and Algonkian, Bulletin No. 86, United States Geological Survey, 1892, p. 470; but compare Foster and Whitney, p. 3.
[2] Foster and Whitney, Lake Superior, part ii., 1851, p. 2.
[3] *Ibid.*, p. 8.
[4] *Ibid.*, p. 11; compare Van Hise, loc. cit., p. 470.
[5] *Ibid.*, p. 2.
[6] Van Hise, loc. cit., pp. 394, 473.
[7] Manual of Geology, 1880, p. 140.
[8] Summarized in Van Hise, loc. cit., p. 469.
[9] Tenth Annual Report of the Director, United States Geological Survey, 1890, p. 59.
[10] *Ibid.*, p. 66.
[11] Van Hise, loc. cit., p. 478.
[12] Van Hise, *American Journal of Geology*, vol. i., p. 113.

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THE PROGRESS OF ASTRONOMY IN 1893.

BY GEORGE A. HILL, WASHINGTON, D. C.

THE year 1893 beheld a most rapid progress in all branches of astronomy. It will be our purpose to call attention to the more important advancements that have been made, and also to items of especial interest, as a complete resumé of the subject would reach far beyond the limits of this article.

In instrumental equipment we have passed beyond our present apparatus, and we are launching out upon a most wonderful improvement in instruments and their accessories. The mounting for the great telescope for the Yerkes Observatory has been completed, and was on exhibition at the World's Fair. The tube will be at least sixty-four feet long. The object glass of forty inches clear aperature is a reality, and Alvan Clark, its makers has said that it will be finished the coming summer.

Brashear has completed the star spectroscope, and is about to commence the solar spectroscope and the spectroheliograph.

Professor Pickering has received from the maker, Clark, a twenty-four inch photographic telescope, the gift of Miss Bruce, of New York. The telescope will be mounted on a high mountain of the Andes, in Peru, and from that elevation its whole energy will be concentrated upon a photographic map of the heavens.

Father Algúe has just departed for Manila, in the Phillippine Islands, at which point he will install an astronomical observatory. The most important instrument that accompanies Father Algúe is an equatorial, with an object glass of nearly twenty inches clear aperature. The mounting is by Saegmuller, of Washington, D. C., the object glass by Mertz, of Munich, and is a companion to that at Strassburg, and the one at Milan, which has been productive of so many interesting observations in the hands of Schiaparelli in his measurement of double stars, and the markings upon the planets, especially Mars. It was the writer's pleasure to recently wish Father Algúe God-speed in his long journey and a rich measure of success from the results of his observations to be made in that far-off land.

The Greenwich Observatory has accepted from the maker, Sir Howard Grubb, an equatorial with an object glass of twenty-eight inches aperature, and the Astronomer Royal reports that it is satisfactory.

The United States Naval Observatory, one of the most magnificent and complete astronomical edifices in the world, both in instrumental equipment and offices for the astronomers, was during the year formally opened.

The Dudley Observatory at Albany, N. Y., has, under the wise administration of its director, Professor Lewis Boss, been moved to a more desirable site, a new twelve-inch object glass by Brashear has been supplied, the other instruments repaired and refitted with all modern conveniences, and a substantial residence built for the director in proximity to the instruments.

Dr. S. C. Chandler, of Cambridge, Mass., has presented to the astronomical world a remarkable series of papers, commenced in 1891, and continued through the past year. The exhaustive investigation undertaken by that gentleman has lead to the proof that the earth's axis of rotation is not invariable, but that a variation of latitude does exist. Dr. Chandler has made a thorough discussion of all astronomical observations, which bear upon the determination of latitude from the time of Bradley down to the present date, and any one who has read his papers must be convinced that he has almost in sight the law that controls the variation in latitude. He has made a thorough discussion of the work of Struve, Peters, Gyldén and Nyrén at Pulkova, with both the prime vertical and vertical circle instruments; observations made at Washington with the prime vertical in 1862–66; Küstner's zenith telescope work; observations made at Cambridge, Leyden, Melbourne and Greenwich; Doolittle's zenith telescope work, and Comstock's and Brown's meridian circle observations at Madison. All these have been discussed in a masterly manner, and from them has been established the fact that the revolution of the earth's pole occupies a period of about 427 days, moving from west to east, the amplitude being a variable and probably entangled with a yearly period.

In connection with what has been said, the reader will find in *Nature*, vol. XLVIII., page 451, a very interesting paper by Professor C. L. Doolittle, given as his address as Vice-President of Section A (Astronomy) at the last meeting of the American Association for the Advancement of Science, held last summer at Madison. Professor Doolittle's paper covers every historical fact connected with the subject of the variation of latitude, besides giving valuable information from the results of his zenith telescope observations carried on so many years at Bethlehem, Pa.

Mr. S. Kostinsky, of the Pulkova Observatory, presented last February to the Imperial Academy of Sciences, St. Petersbourg, a paper containing observations made of close zenith stars with the prime vertical transit instrument at that observatory, for the express purpose of determining the amplitude and period of the variation in latitude, recently dug up by Chandler. From that series an aplitude of 0.60″, with a period of 412 days, is demonstrated. Mr. Kostinsky's paper will be found in Bulletine de l'Académie Impériale des Sciences de St. Petersbourg, tome VII., page 367.

Upon exhibition at the World's Fair was a new form of pendulum devised by Sigmund Riefler, of Munich. Mr. Leman read a very interesting paper before the Congress of Astronomy held in Chicago, which was a description of the pendulum. His paper appeared in the December number of *Astronomy and Astro-Physics*. Accompanying the article was a table extracted from the records of the Royal Observatory at Munich, giving the daily rate of the clock controlled by one of Mr. Riefler's pendulums. The period covered by the table is from September 1, 1891, to September 2, 1892, or one year. Dr. Seeliger, the Director of the Observatory, states, in forwarding the table, that with a variation of temperature up to 30° centigrade no influence worth mentioning on the rate of the clock could be perceived. The mean daily

observed rate was between +0.01 and +0.03 of a second; when reduced to a constant barometer reading it varied between −0.002 to +0.007 of a second. If all of Mr. Riefler's clocks will keep up such a record as that quoted, then it is to be hoped that a number of them will remain in this country. I have advisedly omitted to describe the mechanical ideas contained, as it would be totally unsatisfactory unless accompanied by a drawing of the escapement, which is not at my command.

Dr. Vogel, of Potsdam, has a highly interesting paper in the *Abhandlungen der Konigl. Preuss*, Akademie der Wessenchaften, Berlin, containing the results of his spectroscopic studies upon the new star in Aurigae, discovered by Anderson in 1892. Dr. Vogel's paper is too extensive to more than mention the most important facts. The spectrum of the new star extended far into the violet and showed many broad and bright bands. It was evident to him that the spectrum was not that of a single body, but was made of the superposed and relatively placed spectra of two bodies, which were moving with great velocity. Dr. Vogel then gives a carefully prepared description of the spectrum as it appeared during each night's observation. Professor Barnard, observing the star with the thirty-six inch at the Lick Observatory, found that it appeared nebulous.

A very interesting series of papers have been printed in the *Astronomical Journal*, containing a discussion by Mr. C. L. Poor, of the orbit of comet 1889, V. A rather faint telescopic comet was discovered by Mr. W. R. Brooks on July 6, 1889. The object would not have attracted much attention from astronomical students were it not for the fact that a short series of observations indicated that another periodic comet had been added to the list. That indefatigable worker, Dr. S. C. Chandler, found that the comet had been greatly perturbed by Jupiter in 1886, so much so as to change the orbit from one of twenty-six years to that of between six and seven. Mr. Poor, however, from a much longer series of observations found that previous to 1886 the comet had a period of over forty years. Recently Dr. Julius Bauschinger in a work entitled "Untersuchungen über deu periodischen kometen, 1889 V (Brooks)" I Theil., has from all the published observations, covering a period of over three quarters of a year, obtained a definitive set of elements, and upon those data Mr. Poor has given the orbit of the comet a most exhaustive investigation. Dr. Chandler had attemped to prove the identity of comet Brooks with that of Lexell's comet, 1770, but Mr. Poor seems to be of the opinion, after weighing carefully all the facts, that comet Brooks is not the same as comet Lexell. Dr. Wilson in *Astronomy and Astro-Physics* for November gave a complete resumé of the subject, accompanied with drawings showing the orbit of the comet before and after its approach within the action of Jupiter.

A new catalogue of colored stars has appeared, prepared by Herr Fredrich Krüger, of Kiel. It contains all the stars north of 23°, south declination, that are of a yellow or reddish color, or those that are remarkable through the existence of absorption spectra. The introduction contains a reference to previous catalogues, the work of different observers, their instruments and methods, etc. The catalogue is indeed a valuable one. In No. 300 of the *Astronomical Journal* will be found a second catalogue of variable stars, prepared by Dr. Chandler. He has used the latest observations and has computed the elements for each.

Judging from the earnestness displayed by Charlois and Wolf, the number of asteroids that will be discovered in the future will only be limited by the amount of patience displayed by those observers in exposing their photographic plates to sky. Up to August 19, the orbits of 372 of those strange little bodies scattered between Mars and Jupiter have been computed. In the present year an even forty have been added to our store-house of knowledge, although some of them may be identified as old ones.

During the year three comets were discovered. The first one was the first return of comet of Finlay. In 1886 Mr. Finlay, an astronomer at the Cape of Good Hope, discovered a small comet, which soon proved to be a short period one, and its return was predicted to occur in the spring of the past year. M. Schulof, of the Bureau des Longitudes, Paris, took the orbit of the comet in hand, and the result of his work will be found in the current numbers of the *Bulletin Astronomique*. Mr. Finlay again found the comet, on May 17, very near its predicted place.

In the first week in last July a bright comet appeared on the eastern side of the sun. Its discovery has been claimed by many. It was seen simultaneously at a number of places in Spain, France, and the United States. It shone as a hazy star of the third magnitude, and as its motion was very rapid, upon coming out from the twilight, a tail of ten or twelve degrees in length was seen. Its orbit does not differ from a parabola.

The last comet of the year was found by Brooks, on October 17. It never became very bright, but in December it was well placed for observing, as it was then subpolar for stations in central northern latitudes.

On April 19 a total eclipse of the sun took place, the line of totality first touching the western shore of South America at Saco, then passing northeastward across the continent, cutting Africa to the south of Cape de Verde Islands. It was observed by two British parties, one at Fundium, west Africa, the other at Para Curu, Brazil. A French expedition was also located at Fundium, another at Joal. Two American parties, one the representative of Harvard College, the other of the Lick Observatory, were stationed in Chili. All observers were fortunate in having good weather. All parties gave their attention to photographing the corona, and many of the negatives show a great deal of detail. The corona as seen in April, 1893, was very different from that seen on Jan. 1 or Dec. 22, 1889. It more nearly resembled that of 1871 in the distribution of the coronal streamers.

During the year appeared a volume which is a monument to the work of any astronomer. It is the Cordoba Durchmusterung, by Dr. John M. Thome, the director of the Cordoba Observatory, in the Argentine Republic. The volume contains the brightness and position of every fixed star down to the tenth magnitude between 22° and 42°, south declination. This valuable work contains the first part of the great undertaking by Dr. Thome, namely, the continuation of Schönfeld's Durchmusterung southward. This has been accomplished for the region between 22°, Schönfeld's lower limit, and that of 42°. These are contained in Vol. XVI. of the Cordoba observations, and give the position of 179,800 stars; the second instalment, forming Vol. XVII., will contain 160,580 stars. The latter volume will appear during the year. The great work carried on by Dr. Thome is truly heroic, and his labors have been since 1885 devoted distinctly to the completion of one grand idea, a durchmusterung from pole to pole.

During the year Mr. Edwin F. Sawyer published a catalogue of the magnitudes of southern stars from 0° to 30°, south declination. The catalogue contains the magnitudes of 3415 stars; the average number of observations for each star was four. The system of magnitudes adopted was that of the Uranometria Argentina. It appears to be the most important and accurate photometrical work which has appeared in a decade.

What has gone before has been the progress of astronomy in the year just past.

In closing we cannot omit to offer our tribute to those that have past from the field, and to mention the honors that have been received by the living.

The death last May of the Rev. Charles Pritchard, D.D., F.R.S., late Savilian Professor of Astronomy and Director of the Observatory at Oxford, removed one who left a deep impression, if not in astronomical investigations, in his students that are taking up the work as he had taught them. Dr. Pritchard was a broad-minded man, honest in his purpose, upright in his character, sensitive to the feelings of his students and active in his investigations. Mr. W. E. Plummer has given in *Observatory* for July, 1893, a sketch of Dr. Pritchard's life, a pure, noble one.

In the death of Dr. Adolp Steinheil the astronomical world has lost one who was an authority upon the construction and grinding of object glasses. His death took place at Munich on Nov. 4 last.

On Dec. 6, death once more entered the flock and took from us that eminent astronomer, mathematician and historian of science, Dr. Rudolf Wolf, of the Zurich Observatory. Since 1855 he had been the Director of that observatory, as well as Professor in the Polytechnicum. Dr. Wolf's pen was well handled, as may be seen in his writings, embracing as they do researches in pure mathematics, astronomy, physics and the history of science. In 1852 appeared the first edition of "Taschenbuch of Mathematics, Physics, Geodesy and Astronomy"; in 1858–61 the four volumes of biographies of Swiss men of science; in 1869–72 his "Handbuch der Mathematik, etc.," in two volumes. Probably his most extensive work, the "Handbuch der Astronomie, ihrer Geschichte und Litteratur," has just been completed. All astronomers have at times turned with interest to his "Astronomische Mittheilaugen," commenced in 1856 and continued to the present time. In 1877 he published his "History of Recent Astronomy, Especially in Germany." Dr. Wolf won his reputation in his important discoveries and researches relative to the solar spots. In *Astronomical Journal* No. 309 will be found a very interesting sketch of his life, and from which we have drawn many of our statements as to his work in astronomy.

The December number of *L'Astronomie* conveys the information that the Academy of Sciences of France had decided to confer the Arogo gold medal upon Professor Asaph Hall for his discovery of the satellites of Mars, and upon Professor E. E. Barnard for his discovery of the fifth satellite of Jupiter. The Arogo medal has been conferred only once before, to the illustrious Leverrier, in recognition of his discussion that lead to the discovery of Neptune.

SUNSPOTS AND METEOROLOGY.

BY H. A. HAZEN, WASHINGTON, D. C.

THE spots on the sun are disturbances or storms largely of electric origin. They have a drift or motion along the surface at the equator of 867′ per day, and at lat. 14°,851′. It is known that these spots have a definite period of about eleven years. They have an intimate relation to the fluctuations of magnetic declination, and to the appearance of auroras. An interesting discussion of the question as to the immediate transmission to the earth of an influence from a solar outburst will be found in recent numbers of *Nature*. From time to time serious efforts have been made to show that there is a close connection between sunspots and terrestrial disturbances. It should be noted that mere coincidences between phenomena, no matter how often they are observed, can have little weight in establishing a relationship, unless it can be shown, *a priori*, how or why there is a connection. On the strength of mere coincidences, the ancients were justified in holding the view that the earth was stationary, and all the universe rolled about it, producing the "music of the spheres."

In studies of coincidences, it is very easy to ignore the cases which disagree with a preconceived relation, and to magnify those that do agree. For example: it is believed by some that sunspots have an influence at the earth only as they first appear by rotation on the eastern limb of the sun, and this, too, in face of the fact that some of our most brilliant auroras have appeared with large spots near the centre of the sun's disc. In Nov., 1882, a spot at the centre of the sun could be seen with the unaided eye, and yet it was assumed that the aurora then seen, one of the finest, was due to a few small faculæ just appearing on the sun. No theory of this kind will hold unless it can be shown why the spot loses its influence after it is a few days old. The present writer is well aware that those who adopt this view, that the sunspot has influence only at the time of its first appearance by solar rotation, will not submit to the following crucial test, which is equally applicable to all discussions of this kind: Decide upon the three days in each rotation when the influence should have been the greatest, and also the three when it was weakest, then determine independently the actual meteorologic conditions over any definite portion of the earth, say, for the lake region, or the Ohio valley, or even the whole United States, as regards storms, cold waves, or any other definite phenomenon. A comparison of the data would at once show the value of this supposed influence and a relationship, if there is one.

Attempt has been made also to determine a periodic effect from these spots, or from the source of energy behind them, at specific solar meridians. At first sight, since, as we have already seen, the spots have a different rotation period at different solar latitudes, it would seem as though such a period could not possibly be established. If, however, there are certain influences at specific solar meridians tending to increase spots independently of their drift, such influences may be felt at the earth and would also show themselves by an increase or diminution in the spots whenever that meridian of the sun was at the centre, though it should be noted that this influence can hardly concentrate itself at any one meridian, but must be felt over many days, unless we consider that the sun's influence has tides or blazes up at certain definite times in each rotation. Spots might drift at any velocity, but when they approached such a meridian they would show it in their appearance all the way from the sun's equator to their limits on either side. Various periods have been set for these meridians of maximum influence; some of these are as follows: 25, 25.5, 26, 27, 27 1/4 days, etc. In order to test this question, it has been customary to arrange spot areas according to the selected or determined period for 100 rotations or so, and then to average each day by itself. There is nothing so easy as to arrange figures in this way, but the procedure is fraught with grave danger, as we are liable to cover up just the most important fluctuations by an indiscriminate mean, and our final result shows such microscopic fluctuations that we are tempted to magnify them by an easy multiplication.

A common argument among advocates of such methods, to account for failures in obtaining a period in the past, is that the exact period has not been discovered. One investigator has developed a period of 27.27778 or 27 d. 6 h. 40 m.; another, in studying shorter periods, has made two, one of 7.26917 days (7d. 6.46 h.), and another of 6.16417 days (6 d. 3.94 h.) and so on. This point is not well taken, however, for a little experience with

figures in a known period, by combining them according to a slightly different law, will show at once, not only that we have not the right period, but what that exact period is. For example, take 27 figures in a definite progression and arrange them according to a period of 27 1/3 days, average each 6 periods in succession by themselves and we shall find that each group has its maximum point retarded by two days from the preceding. In meteorologic work it is better to average in groups of 6 and 7 periods in each year, as this eliminates the seasonal effect.

The best data to study the sunspot period are contained in photographs of the sun taken at Greenwich and in India, which together give a superb record for nearly every day of the year. We shall avoid difficulties if we average these figures in groups of ten rotations each, and we would naturally expect to find the influence in each group. If we do not find a thread running through all these groups, it would be pretty good evidence that we cannot get at the influence, even if there is any, in this way, but that it was either entirely masked by other forces, or else was too insignificant to show itself.

I have arranged the sunspot areas from April, 1881, to 1889 in different periods of 25, 25.5, 27 and so on days and in groups of ten rotations each, and have projected curves from these. The curves for the period of 27 days are given here. These curves present the actual data without smoothing or rounding, as this best shows the precise fluctuations. The light vertical lines show the first, fourth, eighth, etc., day of the rotation. Each group of ten rotations has a Roman numeral at the end, and the last (T) is the mean of the 10 groups, or of 100 rotations. We see at a glance that these groups have no common thread at any specific day of the period running through all, and this shows that nothing can be hoped for in this study unless we can first eliminate some of the influences which mask the real effect at the solar meridian. The more reasonable hypothesis is that there is no definite period in this influence.

But this is not all. The last curve (T) shows how exceedingly slight the effect must be, and a few more groups would have practically removed even these slight fluctuations. Again, we see that the maximum and minimum points in (T) are often due to a marked fluctuation in one, or at most in two, of the individual groups, for example: the maximum point in (T) near the 16th day is due entirely to the marked fluctuation in II. at the same day, and, if that group, or perhaps two rotations of the ten in the group, were omitted, this fluctuation would practically disappear. It would seem as though the evidence was conclusive that these crests and hollows in (T) are entirely fortuitous and do not show any influence recurring from rotation to rotation or any physical connection in the fluctuations of the different groups.

Precisely the same reasoning will apply with still greater force to similar studies of meteorologic elements. Here we have a great many local causes modifying the original cosmical influence, and these must be eliminated first. The temperature of the air, for example, is affected by the onward progress of hot and cold waves, by clouds, which serve to diminish the sun's heat by day and terrestial radiation by night, by moisture, by rainfall, by wind, etc. Before we could attempt a study for periods in this element, it would be necessary to take out these effects or to show that they are overborne by the greater cosmic influence.

I do not think that this negative result should lead us to conclude that extra terrestrial forces, aside from heat, have no marked effect upon our weather, but simply that this is not the proper method of getting at these influences. The evidence of such effects is overwhelming, and we may hope for the greatest advances in meteorology in the near future along these lines of research, that is, in developing extra terrestrial influences. Whence comes the enormous amount of electricity stored in the atmosphere at heights of 5,000 to 10,000 ft.? An answer to this single question would be of inestimable value to meteorology. It would seem to be a direct effect from the sun. The present lively discussion and most careful studies upon the influence of electricity in vapor condensation are gratifying and give an earnest of what may still be hoped for. The recent pilot balloon ascensions in Paris up to nearly 10 miles open up a new field for the meteorology of the future. These conditions at 10 and 15 miles must be due to extra terrestrial forces. It is claimed by many that the heat of the sun has no effect upon the air at these enormous heights, and yet, there are indications of most marked fluctuations of temperature on the passage of high and low areas. It has been well established that on the

approach and passage of a low area over Pike's Peak, Sonnblick and other high mountains there is a marked rise in temperature, and the fluctuation is generally greater above than below.

On Mar. 21, 1893, in Paris, a balloon reaching nearly ten miles in the centre of a high showed a diminution of 1° F. in 310 ft. Sep. 17, the same balloon near a low showed a diminution of 1° F. in about 380 ft., or pecisely the same law as on mountains.

Meteorology has been woefully hampered in the past by the theory that all weather changes are due to the heating or cooling, and flowing, or drifting of masses of air comparatively near the earth. Let us look away from these minor conditions and get an insight into the real causes of these conditions, or what is back of them. Let us broaden our view and see how extra terrestrial forces are continually acting upon the upper limits of our atmosphere as well as upon the lower layers and are feeding or generating our storms, cold waves, etc. Let us cut loose from the idea that all our weather conditions are borne along by air currents, for it is plain that this is impossible, since

the velocity of these currents at 5,000 ft. is double that at the earth, and any storm or high area would be very quickly disintegrated by such action.

AUTUMN COLORING OF LEAVES.

BY G. W. M'CLUER, CHAMPAIGN, ILL.

THE subject of this paper was suggested to me more than a year ago by some highly colored leaves of the common red currant that I noticed while rambling in the woods near Urbana.

I shall not take up my notes in the order in which they were made, or of their importance, but shall begin with the smallest.

In the leaves of several species of trees where a principal vein has been broken, the part toward the tip of the leaf has colored earlier and more highly than the rest. Not unfrequently, in lobed leaves, the lobe with the broken rib has been the only part of the leaf that showed any coloring. Leaves torn from the margin to the midrib were not changed as a result of the injury.

The species in which parts of leaves have been seen to color as a result of this injury are soft and hard maple, tulip, white, red and scarlet oak and cottonwood, and blackberry. Probably all plants that color at all would show the same thing.

Carrying the observation a little further, branches of many kinds of trees and shrubs that have been girdled or otherwise injured, have been found to color earlier and usually, though not always, much more highly above the injured or girdled part than below, or than other branches on the same tree that were not injured. As noticed before, the thing that first called my attention to this subject was finding a clump of the common red currant with the leaves on the tips of several twigs colored dark crimson. An examination showed that all the twigs with colored leaves had been girdled by some insect while none of those still green were. Girdled grape branches frequently have very highly colored leaves, but I have never seen them colored on branches that were not injured. Girdled or injured branches with highly colored leaves have been noticed on all our native maples, on cottonwood, elm, wild black cherry, oak, pear and plum.

A large branch on a hard maple on one of our streets used to attract my attention, and I sometimes wondered if its habit of early coloring could not be perpetuated by budding from it. It was finally broken off and was found to be eaten by borers and partly decayed. Branches on some of the hard maples round which wires have been tightly drawn have colored earlier than the rest of the trees. In a few cases where forked branches have split, the one nearest off has been found to be colored more than the other.

The next step would be to find the whole tree more highly colored than those around it on account of some injury to the trunk. Believing that a variety of trees might be produced and propagated that would color regularly every fall, I have watched for such as might offer a good chance to try the experiment. In the artificial forest belonging to the University is a plat of hard maple that has attracted my attention several times, but in looking at trees that were especially brilliant, it was found that all of them had some noticeable defect in the trunk; usually a place where the bark had been destroyed on one side of the tree and the wood left exposed so that it died. In a group of hard maples like these there will frequently be found in the fall all gradations of color from plain green to bright yellow or red, at the same time. There is an individuality in time, depth, and shade of color that is entirely independent of the condition of the tree itself.

Of four young soft maple trees near my house that were planted at about the same time, one has been allowed to get full of borers, and the trunk is so badly eaten that the tree will probably die before a great while, but last fall it was more highly colored than I had ever seen a soft maple before, and the leaves were all off of it before the others had fairly begun to turn. The brightest colored red oak yet seen had a barbed wire drawn tightly around it at about three feet from the ground, and the brightest Virginia creeper had had the bark knocked off in some way.

It is now only one more step to the roots of the trees. We have on the University farm a plat of two year old white oaks that have been grown for planting in the artificial forest. As a preparation for their removal, the top roots were cut last fall. The work was begun while the leaves were still green; when it was about half done, it was stopped and not completed until two weeks later. Within a week after the roots of the first had been cut, there was a very marked change in the foliage. The root pruned trees were all highly colored, while of those not pruned there was only occasionally one that had begun to color.

It is a matter of common observation that trees on hilly land color more deeply than those on level land, but it is not so frequently reported that they also color earlier, though the latter is just as much a fact as the former. Trees on thin land color earlier than the same species on rich land.

It is a common practice among nursery men to stop cultivation before the end of summer and allow the weeds and grass to grow, so that the trees will ripen up their wood earlier and more perfectly. Cultivated land holds moisture longer than uncultivated, and when the uncultivated land has a coat of weeds and grass, the loss of moisture is still more rapid.

It is a very common thing to see a clump of wheat or oats standing out at the edge of a field where it has things more to itself, that is much greener than the general field; or to see thick and thin spots in a field, and the thick always ripe earlier than the thin. Corn grown very thick ripens earlier than corn grown thin. A plat of corn on the Experiment Station grounds, that had no cultivation this past year, the weeds being allowed to grow at will, ripened earlier than cultivated plats of the same variety on each side of it. This shows that the time of ripening depends on other circumstances than the individual character of the plant.

It is not uncommon for our apple trees to shed many of their leaves during a season of severe drouth. If this is followed by heavy rains and warm weather, blossoms and new leaves are very apt to make their appearance. The age of a tree makes a difference in the length of time it uses to complete its season's growth. Young trees, under like conditions, grow longer than older ones, and this is not a matter of shade either, for it is seen more decidedly in nursery stock, as compared with older orchard trees, than in trees in the forest. Sprouts from the stump of a tree that has been cut down grow later than trees of the same species near then. Water-sprouts in apple and other trees grow later than the normal branches; in fact there is but little difference in this respect between the water-sprout and the nursery grown apple tree. Both may be seen until the early winter with tufts of unripened leaves still adhering to their tips.

This thought leads naturally to the subject of determinate and indeterminate growth of plants.

Some species, as the oaks and ashes, will start out a shoot in the spring that reaches its full length in a short time, and the leaves expand and the wood hardens after-

ward. The whole plant is then apparently at a standstill for a time, but when it has matured its buds it starts out again and makes another growth just like the first, though not usually so long. In this way the tree may make two, three, or more distinct growths the same year, depending on the age of the tree, and other conditions. Trees that make their growth continuously stretch out most rapidly at first, becoming slower and slower until growth ceases. The number of buds, leaves or joints which such a branch will form depends on circumstances; its position on the tree, the character of the season, etc. Terminal branches not only grow longer, in both senses, than lateral ones, but produce more buds. Water-sprouts grow longer and produce more buds than either. If a branch is cut off so that all the growth is forced into what would have made a short lateral, it then takes the nature of a terminal branch, and what would otherwise have made a bud for next year's growth, is developed right along into this year's branch, which grows more rapidly, makes more leaves in the same length of time, and also ripens later in the season.

While no notes have been kept, it has seemed to me that our trees growing in a deep rich soil have colored more after a dry season than after a wet one. There can be no question that there is a great difference in the intensity of the color which the same tree will take on in different seasons.

We have in the experimental orchard two kinds of plums, of which some are growing on their own roots, and the rest on the roots of peach trees. The plum trees on peach roots color from ten days to two weeks earlier than those on plum roots, and they also drop that much earlier. In the fall of 1892 the plum on peach roots colored more highly than that on its own roots, but the past fall there was little or no difference in the intensity of color.

The leaves on the outer branches of our dense growing trees color and drop off while the inner ones are still on and green. This is very noticeable in the hard maple and may be seen in the elm and ash to some extent. I have frequently seen hard maples with the naked twigs sticking out two or three feet all round, while the middle of the tree was still green and had dropped scarcely a leaf.

There is a difference in the time of coloring of leaves on trees of the same species, even when they are in perfect health and are under the same conditions. The difference in the time of leafing is frequently spoken of, but I do not remember anyone having noticed that there is a corresponding difference in the season of dropping the leaves in many species. Leaves that color first also drop first; but there does not seem to be any definite relation between the time of leafing and the time of shedding leaves.

There is not only a difference in the season of coloring, but also a difference in the color of individual trees. This difference is very marked in some species, and in others is scarcely noticeable. The ash, elm and walnut each has a characteristic yellow that is comparatively uniform, but other species vary considerably. The hard maple, plum, blackberry, etc., may be seen varying from a pale yellow or orange to a very bright scarlet. The same individuals take the same color, though to the same degree, year after year, just as a variety of apples does, and there is no doubt but that a characteristic season and color could be propagated in the leaf of the maple just as in the fruit of the apple or pear.

It is a practice, not uncommon among some grape growers, to girdle the vines to make the fruit ripen earlier. This makes a difference of something like a week in the season, and the fruit is larger though not so good in quality. Our own plum trees on plum roots have so far borne no fruit, but plum growers inform me that the Wild Goose and some other varieties when grown on peach roots ripen and are gone before those on plum roots have begun to ripen.

The play song beginning, "The higher up in the cherry tree the riper grows the cherry," expresses a familiar fact that is seen not only in the cherry but more or less in all our tree fruits. Those most fully exposed to the light not only ripen more thoroughly, but ripen earlier and color more highly than those in the shade. Apples that grow in the middle of a dense growing tree never do as well nor attain as high a quality as those exposed to the full light, on the outer branches. Whether it is the light or the place where the apple happens to grow that makes the difference, I do not know; grapes color as well and the quality is as good when grown in bags as when fully exposed. Apples grown on hilly or comparatively thin land, where there is little vegetable matter, are more highly colored and are of better quality than those grown on deep rich soils.

There is a correlation in some species between the color of the ripe fruit and the autumn leaves. Generally the blackberry is a very brilliant autumn plant, but the varieties bearing fruits that are white when ripe have pale yellow autumn leaves. Both the black and red raspberry groups have reddish colored autumn leaves, but there are in both these a few varieties with yellow fruits, and the autumn leaves on these are yellow. The yellow fruited plums also have yellow leaves in the fall, and the varieties that have most red in the fruit also have most red in their autumn leaves. Corresponding differences are also seen in the bark of the young wood. I suspect this is an albinism of plants which is related to the albinism of animals.

The fruit is a modified branch and its leaves, and so we have the fruits and leaves corresponding in these ways:

Fruits vary in their time of ripening; leaves in their time of coloring or ripening and falling.

Fruits in the top of some kinds of trees ripen earlier and more perfectly than those in the body of the tree; leaves on the outer branches of some trees color or ripen and fall earlier than those in the middle.

There is an individuality in and a correlation between the color of the ripe fruit and the autumn leaves.

The girdled grape-vine ripens its fruit earlier than those not; leaves on girdled or otherwise injured twigs, branches, or trees color or ripen earlier than those on sound branches or trees, though they do not always fall earlier. The colored leaves may hang on until the frost takes all off together.

Both leaves and fruits color more highly on hilly than on level land; but color in fruit is an indication of maturity.

We have, then, a relation and a regular gradation: The broken leaf, the girdled branch which colors its leaves or ripens its fruit earlier, the brighter color of the injured tree or vine, the earlier ripening and coloring of the fruit and leaves of the plum tree on peach roots, the earlier and higher coloring of both fruits and leaves on broken land, and the earlier and more complete ripening of both leaves and fruits on the outer branches. Probably the leaves on trees in deep rich soils never would color as highly as on those on the rougher land, but the probability is that if we had a longer season for ripening we would have more color.

Is there in the high leaf coloring an indication not of maturity alone, but of an unnatural maturity that would not be found in trees growing in soil and with conditions best suited to their wants?

THE SPOKEN LANGUAGE OF BOTANY.

BY C. MICHENER, SAN FRANCISCO, CALIF.

SOME months ago there appeared in print, over the initials "E.L.G.," the following:

"The eminent dendrologist, Prof. C. S. Sargent, whose good services in the cause of correct nomenclature have been everywhere recognized, has newly discovered that Halesia, long in use for certain American shrubs, is but a homonym, and in a recent issue of *Garden and Forest* (vol. vi., p. 434) has offered Mohria as a substitute. In this choice he does not discover that he has made another homonym; but this is certainly the case, for, as a spoken name—and the language of plant nomenclature is unquestionably a spoken language—*Mohria* is identical with *Morea*, a name already twice employed, first by Medicus and afterwards by Salisbury . . . "—*Erythea*, I. 236.

And thereupon the author, *for the reason he has stated*, publishes a new generic name for Mohria.

Later (*Erythea* I. 246), the same author says: "Maintaining the ground we took that Mohria is at best but a homonym of Morea, we offer the following instead of Swartz's Mohria:" — thereupon again publishing a new generic name.

These quotations are given to show the importance of the question which I wish to present in this paper—a question to which there seem to be two answers, one, that indicated by the course of Professor Greene in the paragraphs quoted, and the other, which I propose now to outline.

This question has been suggested before, but the instances cited are the first which I have noticed that tend toward an active carrying out of an answer to it; and it is in the hope that that solution of the problem may not be adopted—believing as I do that it would lead to ultimate confusion and the injection of the personal equation to a greater degree than ever into the science of nomenclature—that I write this paper.

Professor Greene has stated that the language of plant nomenclatute is unquestionably a spoken language. This, I think, is hardly, as yet, true; for my experience has been that the German spoken plant-name language differs sadly from the English, the English from the French, the French from the American and each from the other.

But it has been decided that uniformity is a useful thing in plant nomenclature. It is perhaps less patent, but extremely probable, that such a spoken language would be a useful thing. These true, it follows that that language should be uniform.

We have agreed that we will not represent any two different plants by identical names. To the date of Professor Greene's notes, above cited, that prohibited identity was identity of letters—of spelling. But we have now to consider a second factor of language—usually the more important, here, I think, the less—sound. And his work indicates that when we find two plants represented by words identical in sound, even though the letters that go to make up the names in each case are not identical, we shall substitute for the name latest in point of time another not identical in sound with the former. That seems to be his solution of the nomenclatural problem upon the addition of the sound-factor.

But, as I have said, I should regret to see it adopted. I think it will be admitted that a means which will involve less change in existing postulates to accomplish a desired result is better than a means which will involve greater change. The desired result in this case is to do away with homonyms in a spoken language of botany. The addition of the sound factor is responsible for such homonyms; (for, for the purposes of this discussion, we will assume that under the rules already in force we have done away with all those whose identity is an identity of spelling—of letters) and it seems to me but reasonable that, if we are to introduce this factor, it should be so introduced as not to disturb in the slightest degree the written language already in existence. The means of doing this is plain. All that is necessary is to assign to each of the twenty-six letters which the written language of botany has employed, a separate, distinct and invariable sound, and we have, as a result, a spoken language in which no sound homonyms exist—in this way obviating the necessity of disturbing in the slightest degree the written language already in existence.

To take, for example, the instance above noted. Professor Greene has noticed the two names *Mohria* and *Morea*. So long as the language of botanic nomenclature remains merely written, these are not homonyms. But if we make it a spoken language, then—in Professor Greene's opinion—they become so. This assumption leads us inevitably to the conclusion that in Professor Greene's spoken language of botany the letter *e* represents a sound identical with that represented by the letter *i*, and that the letter *h* has no sound value—and he is thus compelled to disturb the established written language to adapt it to the suggested spoken language.

In the system which I have proposed, the letter *e* would represent a sound distinct from that represented by the letter *i*, and the letter *h* would have its own definite sound, a sound present in *Mohria* but absent from *Morea;* and therefore I should not be compelled to disturb the established written language to adapt it to the suggested spoken language.

This is the most important consequence of the spoken language which I here propose, and it seems to me that its importance is vital.

A second result of the application of the principle here suggested is that it would produce a uniformity in this spoken language throughout the world; and until this were done, we, as Americans, would have no right to object to some Finnish or Russian botanist making changes in the written language (which is already common to all of us) because, in his particular tongue there might be too close a similarity in the sound of two plant names.

I have prepared a system of sound-values to be given to each letter in accordance with the above plan, observing the following principles:

(1.) Each letter has invariably the same sound in every combination.

(2.) Each letter has a sound distinct from the sound of every other letter.

I do not submit this schedule at the present time, for the reason that I have prepared it, having in view merely the sounds of the Latin-European tongues, and English and German; and I fear that I may have introduced sounds difficult of pronunciation for those who use other languages than these. The practical selection of the most convenient sound in each case is a matter of considerable difficulty, since many names have been published involving peculiar combinations of letters, many of which we are accustomed to regard as being without sound value.

With regard to accent, the simplest rule I have been able to formulate is this: "All words are accented on the last vowel which is followed by a consonant." This rule seems to work very well in this—it is absolute in its application—uniform—, and yet results in variety in the accent of words, some being accented on the antepenult, some on the penult and some on the ultima. I confess it was with somewhat of a shudder that I broke away from classic traditions in the matter of quantity accent; but the advantages of this over the classic rule are so evident, that I feel that I could in time become reconciled to it.

For one must remember that the Latin of botanic names is not classic Latin in many cases, and that the application of quantitative rules in the determination of accent is in such cases merely arbitrary.

I have hesitated for some months about publishing this paper, but it has seemed to me at last that, if the question of a spoken language of botany is to be raised, it is important to define such a language at its outset; and as I have felt that the definition here set forth is one most likely to obviate that potential store of silent synonyms, which must otherwise come upon us, I have suggested it as a basis for improvement.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as a proof of good faith.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The Editor will be glad to publish any queries consonant with the character of the journal.

The Ling on the Pacific Slope.

THE ling (*Lota lota maculosa*) is found over a wide territory of North America east of the Rocky Mountains. I have taken it in the Great Lakes, at Winnipeg, in the Red River of the North, and it was reported to me at the head waters of the Saskatchewan, where it is said to ascend the smaller streams during the spawning season in such numbers that many could easily be killed by a single discharge of a shot gun. I have also taken it in the Missouri at Craig, Montana. In short, it is found in all three of the large water basins of the Atlantic slope—the Saskatchewan, St. Lawrence and Mississippi.

At Golden, B.C., on the Columbia, I was told by a fisherman that in Autumn he had caught ling five feet long on night lines, but I secured no further evidence of their occurrence in the Columbia system during my explorations in that region in August, 1892. When I reached Sicamous on Shuswap Lake in the Fraser system I was at once asked if I had secured any ling, of which they had some for dinner. As described to me, this ling appears to be a species of *Lota*. I did not succeed in getting any specimens at this place, as the Indians, who alone knew where to take them, had left on the morning of my arrival.

Since then I have received a large specimen from Golden, B.C., on the Columbia, which was secured for me by Mr. Green, manager of the Queen's Hotel at that place. A comparison of this specimen with one from Lake Michigan does not show any specific differences. The known distribution of *Lota lota maculosa* is therefore extended to the Pacific slope.

CARL H. EIGENMANN.

Bloomington, Ind.

The Native Calendar of Central America and Mexico.

I THINK it necessary to notice one or two errors in Dr. Brinton's article in *Science*, Feb. 16, for it seems he has made precisely the mistake he attributes to me. But first it is proper to say that, as his reference to Dr. Seler's explanation of *chic-chan* relates to a different work from that referred to by me, my criticism on this particular point was inapplicable.

If Dr. Brinton will examine my article in the *American Anthropologist*, he will see that my reference to the month names is limited expressly to those of the tribes of the Maya stock, hence his reference to the Nahautl names is out of place. It would be well for reviewers to read carefully and make themselves acquainted with that which they are reviewing.

And again Dr. Brinton has wholly missed the point in my reference to the Java week. I certainly thought it was so clear that a person with but half an eye would see that the singular fact alluded to was that the Javanese, in assigning the days of their week and certain colors to the points of space, like the Zunis assigned a *mixed color* to the focus. A similar assignment of mixed color to the centre is seen on plate 12, Borgian Codex.

Further comparison of the Polynesian calendar with that of Mexico and Central America will be seen in a Bulletin now in press and soon to be issued.

CYRUS THOMAS.

BOOK REVIEWS.

Nagualism. A Study in Native American Folk-Lore and History. By DANIEL G. BRINTON, A.M., M.D., LL.D., D. Sc., Professor of American Archæology and Linguistics in the University of Pennsylvania. Philadelphia, David McKay. 1894, 65 p., 8°, $1.00.

"NAGUALISM" is a word which the reader will search for in vain, even in the Century Dictionary, although Dr. Brinton points out that it has been in occasional use in English and American books for seventy years past. It means the doctrines taught by the sect or secret society of the "Nagualists," who for more than three hundred years have perpetuated in Mexico and Central America many of the superstitions and rites of their ancestral heathenism, strongly infused with a debased Christianity; which did not prevent a cordial hatred of that religion and of the race which introduced it from being a cardinal maxim in their creed.

The Nagualists were also adepts in occult art, as skilful jugglers as those of India, telepaths, mesmerists and were-wolves. They had a secret slang or *argot* of their own, full of dark references and symbolic expressions, examples of which are given. The scenes of their mystic rites were glens and caves, where they held licentious orgies or ascetic penances. In the arts of divination and medicine they were acknowledged masters, and their horoscopes, founded on the ancient native calendar, were accepted with blind faith.

Historically, they played an important part in the history of the country, as they were the instigators of nearly all the revolts of the natives against the Spanish power, a fact overlooked by previous writers, but clearly enough shown in this volume. One of the most remarkable facts brought out is the prominence accorded to women in this secret order. They seem to have been the leading spirits, entrusted with its fullest powers, and often to have controlled its most momentous actions.

It will be seen that the subject of this monograph is an entirely new one, and of unusual interest.

Text-Book of Comparative Geology. By E. KAYSER, Ph.D., Professor of Geology in the University of Marbury. Translated and Edited by PHILIP LAKE, M.A., F.G.S. London, Swan, Sonnenschein and Co.; New York, Macmillan and Co. 1893, 596 illustrations, 426 p., $4.50

AMONG the numerous valuable additions to geological literature in the year 1893, probably none will be better appreciated by English speaking readers than this new text-book of comparative geology. The subject is one much misunderstood and undervalued accordingly, not only by the English geologist, for whom the above work is primarily intended, but also here in America. It is frequently regarded as vain to attempt to correlate palæontological zones, and to compare closely one region with another, yet it is safe to say that without some such broad conception of the science little real progress can be made. It is truly remarked by the translator in his preface that it is only to the use of the comparative

method that we owe the striking generalizations of Neumayr and the philosophical views of Suess. Probably this distrust with which comparative geology is regarded by some scientists is due to the confusion of comparative geology proper with the efforts made by some "pigeon hole" geologists to bring together the formations in different widely separated quarters of the globe, and to illustrate in convenient tabular form their relations and equivalence. Opinions differ so widely regarding these correlations that probably no such table of equivalence could ever be constructed which would satisfy more than its author. We do not mean that such attempts are wrong in principle, but that they fail of scientific treatment and are necessarily blind to all that would throw a doubt, or disturb their harmony or proportion.

Comparative geology, as a science, however, is far from drawing such definite lines; it rather seeks to indicate the possibility of such equivalence and discusses not only the facts relative to the important questions of fauna and flora, but also marshals into place the physical features of structure and of inorganic grouping as well as of geographical relations. Not that Dr. Kayser has omitted tables of stratigraphical divisions, but these have been composed with greatest care and with the best understanding of the difficulties as well as of the facts which make the tabulated statement at the same time both desirable and to a certain extent possible.

Dr. Kayser's "Lehrbuch"[1] appeared in 1891, and was immediately accepted by German geologists as a most important addition to their literature, and since that time has been universally regarded as the standard work upon the subject. The original work, which was intended for the use of German students, was naturally largely devoted to the study of the German formations, but even with this preference clearly marked there was yet more detail of extra German countries than had been usual in previous writings. Nor is this particular attention to Germany necessarily a fault, as in that country most detailed study has been given, and no special locality could have been better chosen as an illustration of continental Europe as a whole. Moreover, the author's intimate personal knowledge of the localities described gives additional satisfaction to the reader. Professor Lake, with a full realization of the peculiar insular seclusion of British geologists, has appreciated the value of this work to his fellows and in giving even a pure translation would have contributed a book of greatest value. He has done more than this, however, in his many additions descriptive of countries outside of Germany, particularly, of course, in treating of England, where, as in the former country, the geological series have been most carefully worked out. These additions are particularly numerous in the early portions of the work, becoming somewhat more limited in the discussion of the later formations, owing to the exigency of space. Doubtless in a second edition the writer will be permitted by his publisher to develop the work in proper proportion. As regards the American formations, the comparisons, though brief, are carefully drawn from our best authors, and the data are quite sufficient for their purpose. Further, as has been suggested in a recent review of this same work by Prof. R. D. Salisbury, data concerning American geology are more easily accessible to American students, thanks to the correlation essays of the United States Geological Survey, than data concerning European geology, which this volume supplies. Particularly is this true of the literature relating to the geology of the continent, which appears without exception in languages foreign to us and consequently difficult for reference.

[1] "Lehrbuch der Geologischen Formationskunde," Dr. Emanuel Kayser. Stuttgart, Ferdinand Enke, 1891.

Dr. Kayser is fortunate in his translator, Professor Lake, who has already attained a high position by original work in the same field, both at home and abroad, in connection with the Geological Survey of India. Mr. Lake has aimed to edit as well as to translate and together with the hearty coöperation of the author has brought the book fully up to date, at the same time introducing an extension of field, as has been indicated. In points of variance between continental and English teachings a review of the divergent tenets has in most cases been given, and where exceptionally unqualified statements have been made, though we may not be in full accord with the author, we must at least acknowledge that these statements represent the beliefs most widely accepted by the geologists of to-day.

We can give but a brief review of the contents of this volume, merely indicating the general treatment of the subject. An introduction defines the subject and its sub-divisions, the classification of the sedimentary strata, with a few words on the origin and early condition of the earth. Part I. treats of the Archæan or primitive rocks, their general character, mode of occurrence, origin, etc. The importance of this great group is fully recognized, though the space devoted to its discussion is rather limited. The Palæozoic or "Primary Group" is discussed in Part II., the order of discussion being that adopted throughout the work for each group and for each system, namely, after general remarks an historical summary, followed by a study in geographical grouping, of development and palæontology. It is in the treatment of the Palæozoic that the translator makes his greatest departure from the author, rejecting, here, the latter's division into the Cambrian and Silurian systems in favor of the English divisions of Cambrian, Ordovician, and Silurian. The Silurian of Lake, as is the custom of English writers, extends to the top of the Salina, or Waterlime, series, the Lower Helderberg and Oriskany being included in the second system of the Palæozoic, the Devonian.

The illustrations, which have been drawn in all cases from the original work, include seventy-three plates and seventy figures in the text, or, in all, 596 illustrations, and these form an invaluable part of the volume. The majority of these, which are all well executed, are devoted to palæontological subjects, but we have also many illustrations of structural and physical conditions. The typographical work is excellent, the choice of type, following the German edition in plan, is such as to bring out at a glance the subject matter of each paragraph and thus to add greatly to the value of the volume as one of reference. This is a matter often either neglected by the author or unsatisfactorily accomplished by the publisher, and it is rare that we find so carefully executed a plan as is here observed.

Edward Livingston Youmans; a Sketch of His Life. By John Fiske. New York, D. Appleton and Co. $2.

This is a book which all who are interested in the diffusion of scientific knowledge among the people, and especially all who knew Youmans personally, will like to read. It is written in the clear, smooth style of which Mr. Fiske is master, and as he was one of Youmans's most intimate friends, the biography has the authority as well as the interest which personal acquaintance gives. The most interesting chapters to us have been the earlier ones, which relate the story of Youmans's early life, his work on the farm and his struggles to obtain an education. Then follows the pathetic account of his blindness, which, though most of the time only partial,

almost disabled him from intellectual work during a large part of his early manhood, and sometimes brought him to the verge of dispair. Nevertheless, it was while suffering from this great affliction that he succeeded with some help from his sister in preparing his text-book on chemistry, which at once made him known to the public, and gave him the means of support. This treatise was, in Mr. Fiske's opinion, Youmans's germinal book, all his subsequent work being foreshadowed in it. Next came his career as a scientific lecturer, in which he was successful not only in a pecuniary way but also in increasing the popular interest in the physical sciences.

The rest of the book before us is devoted to those wider enterprises in which Youmans engaged, beginning with his first acquaintance with Herbert Spencer and his agency in securing the publication of Spencer's works in this country. This part of the book is enriched by a large amount of correspondence between the two men, which not only shows their business relations to each other and to their publishers, but reveals many interesting traits of character. There are also letters from Huxley, Tyndall and other scientists, besides many that passed between Youmans and the members of his family. A full account is also given of the establishment of the *Popular Science Monthly*, which, it seems, was successful from the start, and also of the International Scientific Series, which was not started without some difficulty, but which, as our readers well know, proved both scientifically and commercially successful in the end.

The book closes with a series of extracts from Youmans's writings, giving his views on education, on the relations between religion and science and on other subjects; so that readers have before them as full an account of the life and work of the popular scientist as they are likely to need, and one that is worthy of its subject and of its author.

Elements of Chemistry, Descriptive and Qualitative, Briefer Course. By JAMES H. SHEPARD. Boston, D. C. Heath and Co. 1863, 240 p.

THE success of Shepard's Inorganic Chemistry, as exemplified by its use in over three hundred and fifty colleges and schools, and by the high words of praise which have already been accorded it, is sufficient warrant of Professor Shepard's understanding of the needs of a school text-book in chemistry. The present volume is prepared as a briefer course and is intended to meet the needs of secondary school instruction, particularly where chemistry as a study has been forced into a limited period. In addition to the elements of inorganic chemistry, the author has added to the completeness of the work by a chapter on organic chemistry, treating successfully in an elementary manner this rather difficult department. The book is clear, concise, and well adapted for young pupils. It is interesting to note that Professor Shepard's Inorganic Chemistry has been recommended by the Committee of Secondary School Studies, appointed at the meeting of the National Educational Association.

NOTES AND NEWS.

A CROWDED meeting of the members of the Victoria Institute and their friends took place recently at London, England, in the Theatre of the Society of

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Arts, to hear Dr. Prestwich, F.R.S., read a paper "On a Possible Cause for the Origin of the Tradition of the Flood," in which he "treated the subject from a purely scientific standpoint." The chair was taken by Sir George Stokes, Bart., F.R.S. On account of recent indisposition Dr. Prestwich was unable to travel up to London to be present, and had deputed Prof. Rupert Jones, F.R.S., to read the paper for him. The paper described at considerable length the various phenomena which came under the author's observation during long years of geological research throughout Europe and the coasts of the Mediterranean. He concluded by giving the reasons why he considered that these were "only explicable upon the hypothesis of a widespread and short submergence of continental dimensions, followed by early re-elevation, and this hypothesis satisfied all the important conditions of the problem." The age of man was held to be divided into Palæolithic and Neolithic, and he considered rightly so. He concluded by saying that thus there seemed cause for the origin of that widespread tradition of a flood. The paper was followed by reference to a communication from Sir W. Dawson, F.R.S., who welcomed the paper as confirming his conclusion, come to on geological and palæontological grounds, as to a physical break in the anthropic age. The evidence of this was afforded by the cave remains and from a vast quantity of other sources. The discussion which ensued was joined in by a considerable number, including Dr. Woodward, F.R.S., President of the Geological Society—who, in referring to Dr. Prestwich, regretted the forced absence of the Nestor of Geology, and expressed the hope that ere long he might be able to be present at another meeting of the Institute—Sir Henry Howorth, F.R.S., and Profs. T. Rupert Jones, F.R.S., T. McK. Hughes, F.R.S., and E. Hull, F.R.S.

—The latest volume in Appleton's International Education Series is by Susan E. Blow, on "Symbolic Education," being a commentary on Froebel's "Mother's Songs and Games." Miss Blow begins with an attack on Rousseau, which is in the main well deserved and effective; but we cannot agree with the opinion expressed at the end of the chapter that "between the views of Rousseau and those of Froebel there are in my judgment no affinities whatsoever." For the fundamental principle of Froebel's method of teaching is that the child's mind follows a natural course of development to which education, if it is to be successful, must conform; and this principle he obviously borrowed of Rousseau. Nor can we agree with Miss Blow's extreme views about the fondness of children for symbolism and the effectiveness of symbolic teaching in inculcating moral truth and forming virtuous habits. The old symbolic religions were certainly not very successful in improving morality, and we believe that such improvement in children can be much more effectively promoted by direct teaching and the influence of example than by any form of symbolism. In treating of Froebel's practical devices as employed in the kindergarten, Miss Blow has many things to say, some explanatory and some critical, which kindergarten teachers will find interesting and doubtless profitable; but we have no space to enlarge upon them here. We should add that this book contains but a portion of what Miss Blow desires to say on educational subjects, and that she intends to issue another work at some future time to complete the exposition of her views.

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CONTENTS.

ON THE ORIGIN OF ANCIENT QUARTZ ROCKS. J. F. Blake 141

THE NEW GEOLOGICAL MAP OF PENNSYLVANIA. J. B. Woodworth 143

THE SYNTHETICAL POWERS OF MICRO-ORGANISMS. —II. O. Loew 144

INTRODUCTORY ADDRESS TO A COURSE OF LECTURES ON VULCANOLOGY IN THE R. UNIV. OF NAPLES. H. J. Johnston-Lavis 145

STEREOCHEMICAL THEORY. T. Proctor Hall . . 147

BOOK REVIEWS 148

LETTERS TO THE EDITOR:

EARTH WORMS. Charles A. Davis 150

CATS HUNTING SNAKES. F. A. Hassler . . . 151

MESABI IRON RANGE. E. P. Jennings . . . 151

TEMPERATURE IN HIGH AND LOW AREAS. H. A. Hazen 151

MEANDERING RIVERS IN MISSOURI. Arthur Winslow 152

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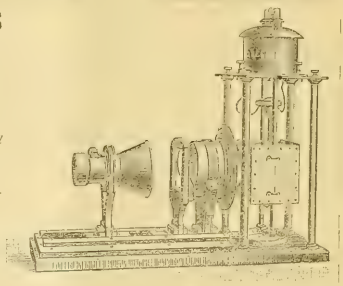

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Knowing that the energy just before the flash exists in the column of air between the cloud and the earth, which column is indicated in the figure by the dotted lines, and that when the air "breaks down" and the flash comes this energy manifests itself mainly as heat along the central core of this column in what we call a flash of lightning, is it not evident that the energy must be transmitted in lines perpendicular to the lines of electrical stress, *i.e.*, in the main horizontally, indicated in the figure by the arrows?

From all this, which is a part of our current knowledge, it appears that the problem of protection from lightning is a problem in the dissipation of energy; that the energy to be dissipated, while we know it to be considerable, as broken masonry testifies, is but a small part of the whole involved in a flash of lightning, by far the larger part being dissipated as heat above the roofs of our houses. If the conditions can be so arranged, by the use of considerable masses of metal suitably placed, that there shall be no state of stress below the roof of the house, then there will be no energy to be dissipated below that level, and all will go well. But it is surely time that the problem of protecting buildings from lightning should be looked upon as one in energetics and that it should be appreciated that the energy present cannot be hocus-pocussed out of the way but must be dissipated in some harmless manner.

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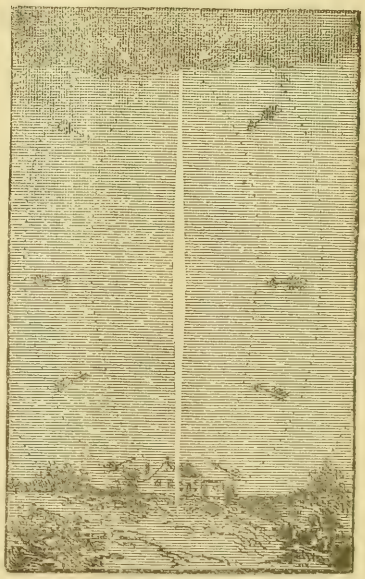

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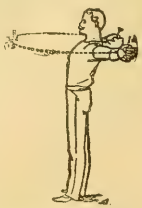

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SCIENCE

NEW YORK, MARCH 16, 1894.

ON THE ORIGIN OF ANCIENT QUARTZ ROCKS.

BY J. F. BLAKE, LONDON, ENGLAND.

THE abundance of large masses of tolerably pure quartz which occur in various conditions in some of the oldest formations is a remarkable circumstance which it has not yet been, I think, attempted to explain. Some of them may be put down in the first instance, though without exhausting our enquiry about them, as sandstones, as for example the "original" Huronian quartzites and the Potsdam sandstone and the quartzites of Shropshire, Sutherlandshire; others, particularly when they are gold bearing, are called reefs, which may or may not be parallel to the stratification of the surrounding rocks. These are well known to characterize the older formations in all parts of the globe. In Great Britain, as at Connemara in Ireland and Schiehallion in Scotland, there are large nearly isolated masses of white quartzite in Precambrian rocks, and, elsewhere, particularly in that portion of the series which I have called Monian, are numerous, discontinuous masses of quartz, as in the Sugar Loaf and Holyhead. There are also, in Anglesey, some still more isolated masses in the shape of quartz-knobs—small outstanding humps of white quartz rock—in the midst of a vast area of schists or ancient tuffs. It is the study of these that has suggested a possible source for a large part of the ancient quartz rocks and quartzites.

Whatever difficulties may have to be got over with regard to the crystalline or colloidal form of the substance, it is certain that from a chemical point of view the quartz of all sedimentary rocks must be derived from such original sources as produce practically pure silica. There are, I think, only three such, viz.: igneous rocks, one of whose mineral constituents is quartz, quartz veins and siliceous springs. The first of these has hitherto been almost the only source considered. To get the grains of quartz out of igneous rocks the other minerals have to be separated, and where this is done with such exceptional completeness, as in the case of a white quartzite, some unusual facilities must be supposed. Quartz veins are an obvious source of quartz pebbles, and when the latter are large, as in many Cambrian conglomerates, they seem necessarily derived from this source. As, however, quartz veins are so intimately connected with siliceous springs, both being the result of crystallization or deposit from water carrying silica in solution, they need not be considered separately.

The point, therefore, that I here suggest is that the deposits from ancient siliceous springs are an important source of the quartz of which some of the ancient quartzites and quartz rocks are composed. The starting point of this theory is undoubtedly the structure of the quartz-knobs of Anglesey. In that island there are scattered over the surface amongst the most ancient rocks, but not specially related to any particular part of them, a number of white glistening bosses of rock, which look in the distance like a whitewashed cottage only that they are usually somewhat larger. Most of these when examined microscopically show some rounded grains, and they might therefore be mistaken for ordinary quartzites. Their peculiar mode of occurrence, however, calling for more careful study, it is seen that in all there is also present a different structure, which in some belongs to the bulk of the rock or even to the whole. It is what I have called a polysonal structure. The whole area of the slide is divided up into a mesh work by clear lines, the interior of the polygons thus produced being spotted over by the minute inclusions common in quartz, which are arranged to a certain extent in relation to the edges of the polygons. (Fig. 1.) Under polarized light it is seen that each polygon is a single crystal, whose crinkly or "sutural" outlines so interlock with those of the adjacent crystals that they could only have formed in situ. (Fig. 2.) In fact, except for all the crystals being quartz, the structure resembles the granitic. Where such a structure is in small proportion to the whole it might be considered secondary, but where elsewhere the bulk of the rock is of this kind we cannot so consider it. If, however, the several crystals were to separate along these polygonal lines, they might easily be rounded into the pebble form. There is, therefore, no objection that I can see to considering the crystalline portion the primary, and the rounded grains the secondary structure. This conclusion is confirmed by certain peculiarities in the mode of occurrence. Thus in one example, which shows the polygonal structure with the greatest clearness, as we approach the knob from a distance we find the surrounding schists first veined with quartz, then the quartz veins become more abundant, then predominate over the schist, and finally at the knob itself nothing is present but the pure white quartz full of minute bubbles. Thus the knob is intimately connected with veins and has no relation to any bedded rock. In another case there is a kind of rock crossing the stratification of the schists and connected at the top with a once horizontal mass which is parallel to the stratification. These cases I take to be illustrations of the pipes of the siliceous springs.

Looking at the matter from the other side there seems no good reason to believe that such siliceous deposits as those of the Yellowstone Park and of Rotomahana should be confined to our own epoch, and yet where are

we to find these representatives in more ancient periods if not in such quartz masses as these? There is this difficulty, however, that the sample of the white terrace of Rotomahana that I have examined has no action upon polarized light and is not, therefore, crystalline. But this difficulty is easily explained by comparison with the glassy form of igneous rocks which does not prevent us looking on other rocks as igneous which are crystalline. An example of a pure quartz vein cutting like a dyke the igneous rocks of Chamwood Forest, Leicestershire, which I have examined, shows a microcrystalline structure, very like that of some felsites, especially the older ones. The association of rounded grains of quartz should also no more surprise us than the association of volcanic ashes with eruptive crystalline rocks and association so intimate in the case of some of the Italian volcanoes that it is

Fig. 1. Structure of a quartz knob in Anglesey seen under ordinary light.

Fig. 2. Structure of the same seen between crossed nicols.

sometimes difficult to say where one begins and the other ends; for instance, on the island of Ischia I have observed an obsidian crowded with fragments. By this comparison I would not be understood to imply that these quartz knobs are "igneous," but I think they are of hydrothermal origin, as to some extent also are true igneous rocks.

With regard to the larger masses, if they are not of the nature of quartz veins, as many of the gold bearing reefs may be, they are probably derived by attrition, etc., from original siliceous deposits of the same nature as the above, and in this case they are not fragments of a dislocated bed of continuous sandstone, but mark the proximate sites of previously existing siliceous springs,—the sum total of the deposits from such bearing naturally no proportion to the size of the rocks up which they have been brought, but being of far greater size. Even the continuous beds of quartzite having an ordinary stratified arrangement may be derived in the first place from such sources, which will in part account for their whiteness.

There are one or two subsidiary observations which lend some support to this contention. As originally noted by Dr. R. D. Irving, the quartz grains of the Huronian quartzites are cemented by an additional growth of quartz around them, and though this quartz is of course of secondary origin, it shows that siliceous water was percolating rocks in the district. But of more importance is the occurrence of pebbles of jasper, and large ones of pure vein quartz in these Huronian quartzites. The former mineral is not an original constituent of quartz bearing plutonic rocks, but it is undoubtedly formed in the wet way. Similar jasper pebbles are formed also in Anglesey in association with limestones where these are themselves associated with the quartz rocks. There are also large tabular crystals of platz hæmatite in the white Potsdam quartzite near Philadelphia. Thus the associates of the quartz in such quartzites are not those common in granites, etc., but those which point to aqueous agencies.

Again, though more rarely, we find limestones associated with the quartzites which have the same peculiarities of distribution and mode of occurrence. These show no traces of organic structure, though there is no reason that I can see why it should not be present even in Pre-Cambrian rocks, but in some cases they do show very decided traces of a tufaceous origin. One example in Anglesey being especially remarkable, as it consists of a compound oolite, layer after layer of irregularly deposited calcite forming the coats, and a pair of the smaller bodies being sometimes surrounded by other coats embracing the two. There are also lenticular patches of bedded limestone probably like the larger quartz masses derived from these—a similar patch of tufaceous-looking, non-organic, limestone occurs in the Huronian series north of Lake Huron.

For these various reasons it seems to me that we must at least consider the possibility of the original source of the quartz in these early quartzites being the deposit from siliceous springs, possibly from the more crystalline character, bursting out under somewhat different conditions as to pressure, etc., from modern ones, and from the abundance of such quartzites we may look upon the later Pre-Cambrian period as characterized by the abundance of such springs, an idea not at all inconsistent with the supposed volcanic origin of many of the so-called Archæan rocks.

—Messrs. Frederick Warne & Co., New York, will immediately commence the publication of the "Library of Natural History," the first installments of which will compose "The Royal Natural History," to be edited by Mr. Richard Lydekker, B. A., F. G. S., F. Z. S., who is already well known to naturalists as a scientist and the author of several works on mammalia, etc. This will form, when completed, an entirely new general natural history, thoroughly abreast of the age; full, accurate and readable, anecdotic, and conveniently arranged. It will contain some 1600 illustrations and a series of 72 colored plates. This work will occupy thirty-six monthly numbers, and will be sold at fifty cents a number. Full details will be contained in an illustrated prospectus now in hand.

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THE NEW GEOLOGICAL MAP OF PENNSYLVANIA.

BY J. B. WOODWORTH, HARVARD UNIVERSITY.

THE *chef d'œuvre* of a *geological survey* is the map. It is a graphic story of the results achieved by the corps engaged in its construction, and shows by a glance wherein progress has been made in defining the limits of the natural resources of a state, in interpreting the age of its rocks, and in establishing the relations of these rocks one to another. It is a bird's-eye view of the geological history of the area, and is an indispensable adjunct of the accompanying report.

The Second Geological Survey of Pennsylvania, under the direction of the venerable geologist, Prof. J. P. Lesley, has brought its results together in the form of a final report of which the first volumes and the map have appeared. The map, dated 1893, is in four sheets on the scale of six miles to the inch, and was made by A. D. W. Smith, assistant geologist, under the direction of Professor Lesley. It is drawn on a polyconic projection, and the data were the county maps published between 1874 and 1892, together with other special maps of particular areas. The original map, so it is stated in marginal notes, was drawn on a scale of two miles to an inch and reduced by photography by Julius Bien & Co. to six miles to an inch.

The legend contains twenty-two blocks of color, two of which have overprints to indicate trap and a limestone bed, respectively. The formation column is as follows:

POST-TERTIARY.
- Alluvium.
- Terminal moraine.

CRETACEOUS.
- Potter's and Fire Clay and Sands.

TRIASSIC (Mesozoic).
- Trap, Red Shales and Sandstones.

CARBONIFEROUS.
- XVII. Greene County Measures.
- XVI. Washington County Group.
- XV. Monongahela River Coal Measures.
- XIV. Pittsburgh Measures.
- XIII. Allegheny River Coal Measures.
- XII. Pottsville Conglomerate.
- XI. Mauch Chunk Red Shale.
- X. Pocono Sandstone.

DEVONIAN.
- IX. Catskill.
- VIII. Chemung. Portage. Genessee. Hamilton. Marcellus. Corniferous.
- VII. Candagalli Grit. Oriskany Sandstone.
- VI. Lower Helderburg Limestone.

SILURIAN.
- V. Salina. Niagara. Clinton.
- IV. Medina. Oneida.
- III. Hudson River. Utica.
- II. Trenton Limestone. Chazy Limestone. Calciferous Sandstone.

CAMBRIAN (including lower Calciferous).
- I. Quartzite.

Slate.
Phyllite.
Serpentine.
Gneiss.

LAURENTIAN.
Gneiss.

The coloration is very similar to that employed in the "Geological Hand Atlas, Report of Progress X.," which appeared in 1885, and, as in the case of that set of maps, the topographic base is omitted. While this omission leaves the colors without the variable shading of contour-lines, which is an obvious advantage where many shades of color have to be used, it detracts from the value of the map since the student cannot infer from the breadth of outcrop alone the relative thickness of a given formation. Where the outcrop is contoured, the inclination of the surface affords the trained map-reader more satisfaction.

The mother geological map of this state was published in 1858 by H. D. Rogers, from surveys made between 1836 and 1857. The eccentricity of the nomenclature applied to the rocks makes this map well-nigh unintelligible to geologists of the present day. From this first general map to the hand-atlas of 1885 was a great step, embodying the results of the first ten years of the second survey. It is interesting to note that in the present final map many minor changes in the limitation of formations have been introduced.

It is always fair to test a map by matching its boundaries with those of adjacent areas, surveyed under different auspices. The geological map of New York on the north is by no means a contemporary of the present high-grade map of Pennsylvania, and be it said, to the chagrin, not of the geologists and palæontologists of the Empire State, but of the legislators and the people, the state has no map comparable to that of the coal commonwealth. New Jersey has a geological map the matching of which with the state across the Delaware is attested by the map under discussion, on which the Palæozoic and Archæan rocks of northern New Jersey adjacent to Pennsylvania are shown in continuous bands. Of Delaware little can be said, but Maryland on the south has, through the enterprise of Professors G. H. Williams and W. B. Clark, a

geological map which, when matched along the Pennsylvania-Maryland line, brings out the single glaring defect in the beautiful chart of Pennsylvania's banded terranes. Where, between the meridians of 77°20′ W., and 77°30′ W., on the northern map the legend reads "Quartzite," the southern more accurate map shows broad fields of ancient basalts (diabase) bordered by a little Cambrian sandstone.

The three maps, of New Jersey, of Pennsylvania and of Maryland, should be in the outfit of every school where geology is taught. The student who would know how a great mountain range is constructed needs to make out a section of Pennsylvania from the ancient crystallines near South Mountain westward across the folds and faults of the Appalachians and the Alleghenies to the shores of Lake Erie. The sheets of this map brought together and mounted form an instructive wall map for class use. Both the teacher and the field student of geology must thank the author of that other memorial of Pennsylvania's history, "The Manual of Coal and its Topography," for this latest contribution to the literature of the science.

THE SYNTHETICAL POWERS OF MICRO-ORGANISMS.—II.

BY O. LOEW, UNIVERSITY OF TOKIO, JAPAN.

WE have in a former communication considered the sources of carbon for the formation of proteids, *i.e.*, for the increase of protoplasm and multiplication of microbes. The sources of nitrogen for the microbes are just as manifold. Not only salts of ammonia and nitrates, but also organic compounds of the most different structure may serve; thus: amines, amides, derivatives of urea and guanidin amidoacids and organic cyanides, *e. g.*, methylamin, acetamid, hydantoin, kreatin, glycocoll, leucin, asparagin, methylcyanide. Of inorganic combinations ferrocyanide of potassium is but a poor source of nitrogen, whilst hydroxylamin and diamid are entirely unfit for use, being very poisonous.[1] Nitrites are less favorable sources than nitrates, and the nitrates are more quickly reduced to ammonia than the somewhat poisonous nitrites.[2]

It seemed to me an interesting question how this reduction of nitrates to ammonia is carried on without the aid of nascent hydrogen; in chemistry this process could thus far not be properly explained. Evidently the living protoplasm, with its atomic motions, was engaged in this process, and I succeeded finally in applying platinum black with an aqueous solution of glucose and potassium nitrate, heating the mixture several hours upon the water-bath, in bringing about this transformation,[3] which may be expressed by the following equation:

$$\underbrace{C_6H_{12}O_6}_{\text{glucose}} + \underbrace{NO_3K}_{\text{potassium nitrate}} = \underbrace{NH_3}_{\text{ammonia}} + C_6H_7KO_6 + H_2O.$$

The peculiar kind of molecular motions in the platinum black transferred upon the molecules of sugar and nitrate brought about an exchange of hydrogen and oxygen atoms, ammonia being formed on the one hand and an organic acid (which was not closely examined) on the other. We call such processes katalytic.

The action of light is not necessary for the reduction of nitrates by bacteria or by any other plant cell. That the nitrogen is not taken as such from the nitrates for the synthesis of the proteids, but that it must be connected first with hydrogen, is shown by the nature of the ordinary proteids which contain about one-third of their nitrogen in form of amido groups.[4]

The different nitrogenous compounds in serving for assimilation of nitrogen (as methylamin, leucin, kreatin, etc.) must evidently be decomposed first with production of ammonia before the synthetical work can begin. This decomposition by the aid of the living protoplasm can take place either under reducing influences or under oxidizing ones, or by the action of water, according to the chemical nature of the nitrogenous substance; as for example:

$$\underbrace{H_2N-CH_2-COOH}_{\text{glycocoll}} + H_2 = NH_3 + \underbrace{CH_3-COOH}_{\text{acetic acid}}.$$

or:

$$\underbrace{CH_3-NH_2}_{\text{methylamin}} + 3O = CO^2 + H_2O + NH_3$$

An interesting fact in regard to the assimilation of nitrogen is the faculty of assimilating atmospheric nitrogen, of the leguminous plants, after their roots entered in symbiosis with certain kinds of bacteria, as was shown by Hellriegel. Also in this case, however, the gaseous nitrogen is not directly used for the synthesis of proteids, it must be first converted into an ammonia compound, most probably into ammonium nitrite by those bacteria.

$$N_2 + 2H_2O = NO_2.NH_4$$

Also this process may be imitated, as I have demonstrated, if platinum black in presence of gaseous nitrogen or air is moistened with caustic lye.[5]

In regard to the assimilation of sulfur it is also found that very different combinations can be used; thus sulfates and sulfites, methylsulfide, sulfonic acids, as, for instance, taurin, sulfones like sulfonal, etc. Evidently there must be also here formed at first a suitable group before the sulfur can enter into the forming albuminous molecule. If we consider that the sulfur can easily be split off from proteids (in part at least) in the form of sulfuretted hydrogen and that the entire character of proteids leads us to the conclusion that the sulfur is contained in them in the shape of the hydrosulfyl group, then it becomes highly probable that H_2S is the combination first formed from all the different sources of sulfur. The sulfates must be therefore *reduced* for the assimilation of sulfur. I have shown, also, here, how such a process can be performed katalytically:[6] if we heat a solution of oxymethyl sulfonate of sodium with platinum black and carbonate of sodium we can soon observe the formation of sodium sulfide. This process is certainly a very interesting sort of reduction, and may be expressed by the following equation:

$$2\,(CH_2OH-SO_3Na) + Na_2CO_3 = Na_2S + SO_3Na_2 + CH_2O_2 + 2\,CO_2 + 2\,H_2O$$

Our considerations have led us to the conclusion that formic aldehyde, ammonia and sulfuretted hydrogen are the immediate material for synthesis of albuminous matter or proteids. A clue what way the synthesis may take is furnished by the decomposition of proteids taking place under certain conditions in the higher plants, whereby asparagin is formed in very large quantities. On the other hand we find that asparagin is rapidly converted into albuminous matter in presence of sulfates and glucose. Therefore the most probable conclusion is, that the asparagin is first converted into a substance, capable of yielding albumen by a so-called condensation process and that this substance must be the aldehyde of asparaginic acid. Albuminous substance would thus be formed in a nearly analogous process to the formation of sugar from formic aldehyde. I have demon-

[1] Compare O. Loew, "A Natural System of Poisonous Actions," Munich, 1893.
[2] O. Loew, Biol. Centralblatt, vol. x., p. 588.
[3] Berichte der D. Chem. Ges., vol. xxiii., p. 675.
[4] O. Loew, *Journal f. Prakt. Chem.*, vol. xxxi., p. 134.
[5] Berichte d. Deutschen Chem. Ges., vol. xxiii., p. 1443. The assertion of Schoenbein, that ammonium-nitrite is formed in small quantities, on evaporation of water in contact with air, was shown to be erroneous by A. Baumann and Neumann.
[6] Ber. d. D. Chem. Ges., vol. xxiii., p. 3125.

strated[7] eight years ago that several sugars result thus, among them a fermentable one, called by me methose and declared later to be inactive laevulose by Fischer. If we now express our view on the formation of albuminous matter in plant cells, especially in the microbes, by equations, we obtain:

I. $4CH_2O + NH_3 = C_4H_7NO_2 + 2H_2O$

formic aldehyde — asparaginic aldehyde

II. $3C_4H_7NO_2 = C_{12}H_{15}N_3O_4 + 2H_2O$

III. $6C_{12}H_{17}N_3O_4 + 12H + H_2S = C_{72}H_{112}N_{18}SO_{22} + 2H_2O.$

simplest expression for albumen

This theory would doubtless indicate the simplest way possible for the formation of proteids; it is true, that some objections could be raised especially in regard to equation I., but we will at a future occasion explain what principal conclusions drawn from this hypothesis were confirmed by experiments.

[7] *Jour. f. Prakt. Chem.*, 1886, p. 321; and Ber. d. D. Chem. Ges., vol. xx., p. 447.

INTRODUCTORY ADDRESS TO A COURSE OF LECTURES ON VULCANOLOGY IN THE R. UNIV. OF NAPLES.

BY H. J. JOHNSTON-LAVIS, M.D., M.R.C.S., F.G.S., ETC., NAPLES, ITALY.

VULCANOLOGY, or the science which concerns volcanoes and their phenomena, is a very important branch of geology, or the science which treats of the earth's crust in general. Geology is yet hardly a century old, because before that time it consisted of little else than a collection of romantic hypotheses and incredible superstitions. This remark applies with still greater force to vulcanology, for the study of which it is most necessary to possess an extensive knowledge of physics and chemistry, besides a highly developed faculty of observation. Notwithstanding, for a century or two previous to the nineteenth there were acute observers, and we in Naples well know such names as those of Sorrentino, Duca e Padre della Torre.

Towards the end of the last century the active and extinct volcanic regions of Italy attracted the attention of four great scientists, each of a different nationality: these four illustrious men were Spallanzani, Sir William Hamilton, Dolomieu and Breislak. Although their nationality was different, they had two merits in common—that of scientific truth and that of Baconian methods of reasoning. In other words, they were pure scientists, since by that term we understand one who observes carefully, records neither more nor less than he observes and draws from these facts and those collected by others his conclusions without disregard to a clear knowledge of the principles involved, and without imagining facts that never existed which give rise to the enunciation of romantic hypotheses and scientific castles in the air. It is therefore more to these four men that we owe the advance of human knowledge concerning volcanoes than to all the writers who preceded them.

In the first years of the nineteenth century, vulcanological literature was enriched by many scientists, because as the allied sciences were then making great strides, they were able to offer to vulcanologists much more powerful and accurate means of investigation. Thus we had Humboldt, Scrope, Daubeny, Pilla and Gemmellaro.

Following these came a phalanx of illustrious students of that branch of geology, some still amongst us, others unfortunately dead in person but living and immortal in the memory of man as heroes of science and of human knowledge. Amongst these we may enumerate Lyell, Dana, Scacchi, Palmieri, Silvestri and Phillips, whilst at present many younger and gifted investigators are not wanting.

No other branch of science has been so heavily burdened by extravagant hypotheses which have so much retarded its progress as that of vulcanology. It is not only in the first half of the present century that we find an extensive literature, the production of men who advertised themselves as scientists when in truth they did little else but write memoirs and books to promulgate and sustain fantastic, extravagant, imaginary and impossible hypotheses. Even to-day only those who like myself have had the misfortune to be obliged to review the vulcanological literature can appreciate the large quantity of rubbish which is yearly published in the name of science. Nevertheless, amongst so much of this chaff we do meet with grain, but also very good grain.

As a subject of study, Vesuvius holds the first place in all vulcanological investigations of this and the last century. A few figures will make this fact more evident. Some four years since my wife and myself collected the titles of books, memoirs, and other writings referring to the south Italian volcanoes for the purpose of publishing a bibliographical list. We found the following numbers:

Graham's Island or Isola Ferdinandea	28
Roccamonfina	33
Lipari Islands	119
Alban Hills	210
Campi Phlegræi	539
Etna	880
Vesuvius	1552

From this table we comprehend how much has been written concerning our great active volcano, which we find constitutes nearly half of what has been written about all the volcanic regions south of Rome. If we add to these the titles referring to the Campi Phlegræi we then find that in a total of 3361 not less than 2091 concern the volcanic district around Naples. Let me, however, give you a still more striking fact. The Naples branch of the St. Alpine Club possesses the richest vulcanological library in existence. The catalogue contains more than 7000 entries of papers, books and manuscripts. However, in this number are included books that not only treat of vulcanology but in a large part refer to seismology and to a smaller extent to geology. It will be seen, therefore, that the Neapolitan volcanic district represents more than a quarter of all vulcanological literature.

It is true that the history of Etna and the Æolian Islands reaches farther back than that of Vesuvius, but on the other hand the history of this latter is by far the most complete. From a chronological point of view Vesuvius and also the Campi Phlegræi have a more important place in history than any of their rivals. Even if the Pompeiians, the Herculaneans and the Stabians did lose all their property eighteen centuries since, the modern world has recovered it as achæological treasures whose value represents, from the point of view of culture, many times the original one, and the compound interest on the same for the whole interval; and this we owe to our Vesuvius. The phlegrean region around Naples is so enchained with the poetry of the heroic and classic periods, that without it the legends of Cuma, of Pithecusa, of Sparctacus, of Partenope, of Baja and so many others, which fills pages and pages of ancient history, would not exist.

Sometimes poetic ecstasy attacks the mind of the scientist; for quite the contrary to what the general public believe, science, rather than abolish poetic senti-

ment, further developes it, but in a more serious and refined form. If you will allow me I will describe to you one of my day dreams concerning the ground that we are now standing on, and which we will entitle the "Campania Felice without its Volcanoes."

When, as we wander around Naples, we reach the hill of Cuma and we encounter a few ruined walls and a few pot-sherds that peep out through the rich vegetation of that spot, where now the only inhabitants are the goats and the lizards, our imagination speeds back for nearly three millenniums when this same rock, almost in its present state, was chosen by the daring Greek navigators as the site of their new colonial town. All of us know the history of Cuma, all of us know that this little bit of Italy for the half of historic time held a very important place. We are deeply impressed when we make an effort to conceive clearly what three thousand years really is, how many generations lived and died during that time and in that place—but far, far greater are we impressed when we think that three thousand years is but a fraction in the *geological* history of that hill, and finally our mind fails to grasp the value of time when we consider that the physical record of this hill is not more than a minute fraction of the geological records of our globe.

Without going very far back in the geological history of our region I will ask you to follow me to the first part of the pliocene epoch, an epoch, as all know, considered quite near our own time. All of us now admire the beauty of the Gulf of Naples, which has few rivals in the entire world, but at that time its conformation was very different to what it is now. It then formed a very much larger gulf, represented to-day by the plain we call the *Campania Felice* with a large part of the Terra di Lavoro. We must figure to ourselves a broad gulf, limited on the north by the promontory of Gaeta, where its confines were limited by high limestone cliffs. Its coast had roughly the following trend: From Gaeta, it corresponded with the present provincial road to close under Castelforte and from there was almost represented by the valley of the Garigliano as far as the gorge between Mt. Faito and Mt. Cammino, by which narrow strait it was in communication with the sea covering the present plain of Cassino. Winding round the south of Mt. Cammino, it again extended northwards to Mignano. The eastern coast of this strait corresponded with the present line of railway from Mignano to Taverna S. Felice, which coast turning eastwards passed under Presenzano to extend into the mountains by the valley of the Volturno. From this point the coast, winding round several islands, represented to-day by hills and mountains separated from the main mass of the Appenines, extended into these latter, forming so many fiords. The sea then covered all the plain, and its waves beat the foot of the mountains behind Pietramelara, Pignataro Maggiore, Capua, Caserta, Nola, Palma, Sarno, Angri and Castellamare and then corresponded roughly with the present coast of the peninsula of Sorrento. In the middle of this great gulf rose two important isles—Capri and Mt. Massico, besides a quantity of smaller ones. Numerous fiords penetrated the Appenines where to-day we have the Garigliano, the Volturno, Valle di Maddaloni, Valle Candina, and the Valle di Avella. In fact this part of the coast of Italy in those pliocene times was very similar in configuration to that of the Istrian coast of to-day.

The rivers brought down to the sea sand and mud which, settling at the bottom of the gulf, prepared an almost flat sea bed, which later was to form the foundation of the Campanian plain. At that period the Campania Felice was only sea, and where to-day flourish vines, oranges, lemons and gardens of flowers then only grew marine algae.

The great fissure in the earth's crust which corresponds with the western coast of Italy, and along which were formed the Italian volcanoes, opened a way for the igneous magma to the bottom of this gulf. Numerous eruptive centres were formed, giving rise to the volcanoes of Tschia, Roccamonfina, Campi Phlegræi and Vesuvius. The order in which these different groups were formed is still an unsolved enigma. Tschia, as has been long known, shows by the fossiliferous deposits clothing its flanks to have undergone great elevation since its original formation, and as we have no such evidence in the other volcanoes, we must conclude for the greater antiquity of Tschia. I also believe that the volcanic group of Roccamonfina is very much older than that of the Phlegræan Fields and Vesuvius because we find the *piperno* and the *pipernoid tuff*, very old volcanic deposits in these regions, forming a mantle over Roccamonfina when it was almost a complete mountain. It must not be forgotten, however, that in the "Museum Breccia" first described by me we have evidence of the effusion in these regions of many varieties of rocks long anterior to the *piperno*.

Gradually the large quantity of lava and fragmentary materials that were ejected at the bottom of the gulf greatly diminished its depth, and this, combined with general elevation, resulted in the emergence of a number of volcanic islands at Roccamonfina, Tschia, Naples; and probably Vesuvius was at first, like the others, an island. Constant general elevation soon drove back the sea, leaving high and dry all that region we so well know. This plain with its volcanic hills and mountains constitutes one of the most beautiful, the most fertile and the healthiest regions of our earth if man were more capable of appreciating, enjoying and developing this *pezzo di cielo caduto in terra*.

So many are the advantages that our Vesuvius offers to the student of vulcanology that I think it advisable to pass them in review. This renowned volcano occupies a very central position in the civilized part of the globe, only a few kilometres from Naples, with all the resources of a great city, and in communication by numerous lines of passenger vessels and railways with all parts of Europe and America. Means of visiting Vesuvius are numerous, whilst the volcano is now entirely surrounded by a network of railways, besides good roads. By road and railway the top of the mountain can be reached, and upon its flanks can be found hotels and accommodation of all kinds, besides a meteorological observatory intended to be used for the daily study and record of its varying phases. The simple but interesting form of the mountain, the extraordinary and unrivalled variety of its productions, which surpass in number, beauty and interest those of any other volcano yet studied, are also a matter of maximum importance to the student. Besides this, of equal importance we must reckon that continuous activity with variation within such limits as to permit detailed study on the spot and still more fully in the university laboratories or elsewhere.

Besides, scattered over Italy and within a few hours' reach are several other active volcanoes, each having its own special interest, besides a large number of extinct ones and subsidiary volcanic phenomena, all of which beyond their scientific interest have a very great importance to the inhabitants from an agricultural, industrial and hygienic point of view. This is especially the case in the immediate vicinity of the active ones, so that it becomes the duty of the government to maintain a system of observation and record and to develop a school in which students may acquire a scientific knowledge of vulcanology.

At Naples we have a chair of terrestrial physics, but as under this name is included a vast amount of different

groups of phenomena it is impossible for its holder to give a fair share to vulcanology alone. So far the only chair of vulcanology was that of Catania, which was so well occupied by the late Professor O. Silvestri and which after his premature death was abolished.

These are, therefore, the reasons why we shall give a course of lectures on vulcanology in the University of Naples. My lectures will not be simply theoretical ones, for we shall make a number of excursions into the surrounding volcanic districts, where we can examine the phenomena and materials as they occur.

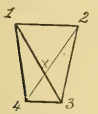
STEREOCHEMICAL THEORY.

BY T. PROCTOR HALL, PH.D., TABOR, IOWA.

In the September number of the Journal of the Chemical Society Mr. S. U. Pickering points out that the fundamental idea of the tetrahedral arrangement of atoms about a carbon atom is that of the most symmetrical arrangement of four spheres about a fifth central sphere, and that the same principle leads to a triangular arrangement about triad nitrogen and a hexagonal arrangement about pentad nitrogen. In the case of the carbon atom this idea has proved so satisfactory that we are naturally anxious to see it tested in regard to all the other atoms. It is not, indeed, to be expected that the actual relations of atoms in three-fold space can be perfectly represented by any theory which takes account only of such relations as can be expressed in a two-fold diagram. Hence, stereochemistry will inevitably become more and more prominent as our knowledge of molecules increases. It may be worth while, therefore, to consider more fully than appears to have yet been done the arrangements which the application of the same fundamental idea require for other atoms having higher atomicities. In the following list the number of possible isomers of each kind is given. I have made no attempt to compare these with the facts; indeed that may not be possible as yet in many cases; but if the fundamental stereochemical idea is to be fairly tested, one of the first necessities is that the logical conclusions from it should be fairly and fully stated, and this I have tried to do.

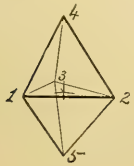
In the formulæ following M stands for the central atom, whose valance is given; A, B, C, etc., stand for monovalent elements or groups about M whose places in the diagram are indicated by the order of their positions in the formula. For example, MBA_2CB means that about M are grouped two atoms or groups of the kind A, taking the positions marked 2 and 3 in the diagram, two of the kind B in the positions 1 and 5, and one of the kind C in the position 4.

1. A Tetravalent atom may form the basis of two isomeric molecules, namely:



M^{iv} (2) { ABCD / ABDC.

2. Pentavalent atoms,—Hexahedron.



M^{v} (2) { AB_4 / B_4A.

M^{v} (4) { ABC_3 / AC_3B / C_3AB / BC_3A.

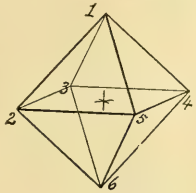
M^{v} (3) { A_2B_3 / AB_3A / B_3A_2.

M^{v} (6) { AB_2C_2 / AC_2B_2 / ABC_2B / $ABCBC$ / B_2C_2A / C_2B_2A

M^{v} (10) { $ABCD_2$ / $ABDCD$ / ABD_2C / $ACDBD$ / ACD_2B / AD_2BC / $BCDAD$ / BCD_2A / BD_2AC / CD_2AB.

M^{v} (20) { ABCDE / ABCED / ABDCE / ABDEC / ABECD / ABEDC / ACDBE / ACDEB / ACEBD / ACEDB / ADEBC / ADECB / BCDAE / BCDEA / BCEAD / BCEDA / BDEAC / BDECA / CDEAB / CDEBA.

3. Hexavalent atoms,—Oktahedron.



M^{vi} (2) { A_2B_4 / AB_4A.

M^{vi} (2) { A_3B_3 / A_2B_3A.

M^{vi} (2) { ABC_4 / AC_4B

M^{vi} (3) { AB_2C_3 / ABC_3B / $ABCDC_2$.

M^{vi} (6) { $A_2B_2C_2$ / A_2BCBC / A_2BC_2B / A_2CBCB / AB_2C_2A / $ABCBCA$.

M^{v} (5) { $ABCD_3$ / ABD_2CD / $ABDCD_2$ / ABD_3C / ACD_3B.

M^{vi} (30) { ABCDEF / ABEDCF / ABCEDF / ABDECF / ABDCEF / ABECDF / and similarly / A———E (six forms) / A———D " / A———C " / A———B "

M^{vi} (8) { ABC_2D_2 / $ABCD_2C$ / $ABCDCD$ / ABD_2C_2 / $ABDC_2D$ / $ABDCDC$ / AC_2D_2B / $ACDCDB$

M^{vi} (15) { $ABCDE_2$ / $ABEDCE$ / $ABDCE_2$ / $ABECDE$ / $ABCEDE$ / $ABDECE$ / $ABCE_2D$ / ABE_2CD / $ABECED$ / $ABDE_2C$ / ABE_2DC / $ABEDEC$ / $ACDE_2B$ / ACE_2DB / $ACEDEB$

4. Heptavalent atoms,—Irregular.

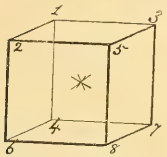
The nearest possible approach to a regular arrangement of seven atoms around one is perhaps that indicated in Figure 4, in which one atom is above M, three others are at the corners of a horizontal triangle and the

remaining three at the corners of a lower triangle alternate with the first. These positions are here assumed only for the sake of the symmetry that then appears with reference to the position 1. A very small change of positions will suffice to make the same symmetrical arrangement with reference to any of the other positions 2, 3, 4, 5, 6, 7; and it is assumed that so much motion may take place that only one form of the molecule MAB_6 is possible. Under such conditions the prediction of isomeric forms is largely guess work; but the following, which include most of the forms actually found, seem probable:

M^{vii} (2): A_2B_5, AB_5A.

M^{vii} (3): B_4A_3, BA_3B_2, AB_4A_2.

5. Oktavalent atoms,—Cube.



M^{viii} (3): A_2B_6, AB_6AB, AB_6A.

M^{viii} (3): A_3B_5, A_2B_5A, AB_2ABAB.

M^{viii} (7): AB_2C_5, ABC_2BC_3, ABC_3BC_2, ABC_4BC, ABC_5B, $AC_3B_2C_2$, AC_5B_2.

M^{viii} (7): A_4B_4, A_3BAB_2, AB_2A_2B, $A_2B_2AB_2A$, A_2B_5ABA, A_3B_4A, A_4B_4A.

M^{viii} (13): AB_3C_4, AB_2CBC_2, AB_2C_2BC, AB_2C_3BC, AB_2C_4B, $ABC_2B_2C_2$, ABC_2BCBC, ABC_3B_2C, AC_3B_2C, AC_3B_2CB, $AC_2B_2C_2B$, AC_2BCBCB, $AC_2BC_2B_2$.

M^{viii} (3): ABC_6, AC_3BC_3, AB_6B.

M^{viii} (22): $A_2B_2C_4$, A_2BCBC_3, $A_2BC_2BC_2$, A_2BC_3BC, A_2BC_4B, $A_2CB_2C_3$, A_2C_2BCBC, $A_2C_2BC_2B$, $A_2C_4B_2$, ABC_2ABC_2, AC_3ABCBB, AC_3ACB_2, AB_2CAC_3, AC_3AB_2C, AC_3BAC_2B, $ABCBAC_3$, ACB_2AC_3, $ACBCABC_2$, ABC_2BC_2A, ABC_3BCA, AB_2C_4A, ABC_4BA.

M^{viii} (24): $A_2B_3C_3$, $A_2B_2CBC_2$, $A_2BC_3B_2$, $A_2CBC_2B_2$, $A_2B_2C_2BC$, $A_2C_2B_2BC$, $A_2BCBCBC$, A_2CBCB_2C, $A_2BC_2B_2C$, A_2CB_2CBC, AB_3AC_3, ACB_2ACBC, ACB_2ABC_2, $ABCBACBC$, $ABCBABC_2$, AC_2BAB_2C, ACB_2AC_2B, AC_2BACB_2, ABC_2AB_2C, AB_2CACB_2, AB_3C_3A, AB_2CBC_2A, AB_2C_2BCA, AB_2C_3BA.

The possible isomers of more complex molecules of this class are very numerous. But there is no advantage in writing them out since they are not found in practice.

When divalent or trivalent atoms or groups replace two or three monovalent atoms in the preceding formulæ, the possible forms are in all probability restricted to those in which the replaced atoms are adjacent to one another. The molecule P^vNO, for example, is of the form $M^v A_2 B_3$, but only one of the three isomeric forms given in the table is in this case possible.

If there were examples of still higher valence there would be no regular arrangement possible until twelve atoms were arranged about the central atom, and these twelve would crowd one another or be necessarily so much closer to one another than to the central atom that the form would be unstable. The same cause of instability would of course prevent the formation of molecules in which more than twelve atoms are grouped about one. We have then a plausible reason why valence should not exceed the number eight.

A possible explanation of the fact that elements having odd valence remain odd and those having even valence remain even may be found in the supposition that atoms whose valence is even are symmetrical while those having odd valence are asymmetrical,—that is to say, the latter have their centre of attractive force for other atoms not coincident with their centre of gravity; and on the farther supposition that in order to form a stable compound the atoms must form a more or less symmetrical arrangement about the central atom. An atom having odd valence will then attract one other atom and form with it a symmetrical molecule. A farther addition of one atom destroys the symmetry. The addition of a third restores it. So that if symmetry is a necessary condition of stability the valence must increase by twos. On this hypothesis the stereochemical structure of molecules whose central atom has odd valence will be entirely different from what is represented in the preceding diagrams. The anomaly of chlorine, whose most stable oxygen-acid (per-chloric acid) is the one whose molecule appears most irregular in the above diagrams, disappears, and the arrangement required for the molecule of perchloric acid is perfectly regular. The arrangements for the odd valences, in fact, become the same as for the even valences of the next higher order with the omission of one point whose place is supposed to be (in part) occupied by the asymmetry of the central atom. In some cases the number of isomers possible on this theory differs from the number given in the preceding table. Such cases may decide which (if either) of the views here presented is preferable.

BOOK-REVIEWS.

Investigations on Microscopic Foams and on Protoplasm: Experiments and Observations directed towards a solution of the question of the physical conditions of the phenomena of life. By O. Bütschli, Professor of Zoology in the University of Heidelberg. Authorized Translation, by E. A. Minchin, B.A. (Oxon.), Fellow of Merton College, Oxford. London, Adam and Charles Black, 1894. 1 vol., 8vo, xvi, 379 p., with xii plates.

This is an attempt to determine the character of protoplasm, by analogical reasoning from the microscopical appearance and behavior, in water, of drops of oil containing soluble substances, such as salt or sugar, which, by their attraction for the water, cause it to enter into the oil and produce a solution which fills and expands the cavities previously occupied by the salt or other substance, thus converting the oil into a fine froth.

Although the author formally divides his work into only two parts, viz., I. that relating to the structure of Oil Foams and II. that relating to the structure of Protoplasm, it may be more conveniently considered as consisting of four divisions,—1. treating of the author's experiments with microscopic foams, 2. recounting his observations upon living protoplasm, 3. reviewing all known theories of protoplasmic structures, and 4. giving Professor Bütschli's own conclusions as to the physical nature of protoplasm.

In the words of the translator, "protoplasm is conceived of in this work as having the structure of a froth or foam in which minute droplets of a watery liquid take the place of air in the bubbles of an ordinary foam." The author applies to this formation a term which means pretty nearly "honeycomb structure," but which Mr. Minchin finds it more convenient to translate as *alveolus*, using as the related adjective the word *alveolar*.

The method of experimentation and comparison made use of by the author of this work is of course not wholly new, and this is not his first presentation of the subject. As far back as 1878 Professor Bütschli broached the general idea worked out in the present book, and although he has modified his views from time to time to meet the criticisms of fellow-investigators, or to accommodate them to facts brought to light by his own observations, this may be regarded as in the main a final defence of his original thesis,—namely, that protoplasm, while generally presenting an alveolar arrangement, is in itself structureless, and that its manifestations of activity are explainable on purely physical grounds.

The aims of his experiments have been, first, to produce artificial foams of the fineness of those believed to exist in protoplasm and comparable with the latter; second, to induce in his artificial plastides the phenomena of streaming, locomotion, and growth by intussusception; and, third, to show that the structure of living protoplasm and its so-called vital movements are similar in character to those produced by his methods. In pursuance of his first object he has undoubtedly found a simple method of making oil froths with a meshwork as fine as modern optical appliances can render visible, and to this extent he has matched the reticular appearances brought to light during recent years in vegetable and animal protoplasm. But, unfortunately, the microscope has not yet reached that degree of perfection, even with its latest apochromatic objectives and compensating oculars, which will enable us to speak with entire positiveness of the real form of any of the smallest structures we are able to discern, and so, with reference both to these microscopical foams and to the reticulated protoplasm of living organisms, we cannot at present depend entirely on sight and wholly dispense with imagination. In his alveolar oil-drops our author properly assumes the right to argue from the larger cavities down to the very smallest, and to assume from his employment of a structureless colloid that the boundary walls and the interconnecting threads are nothing but films of oil in different degrees of tension. But in the case of protoplasm we may fairly question whether he is thus far justified in carrying his analogy beyond the bound of mere superficial resemblance.

In pursuance of his second aim, Professor Bütschli has found that when the exchange takes place between the contents of the oil vacuoles and the surrounding water, a streaming movement is set up, the currents of which, both within and without the drop, may be made visible by mixing India ink or other coloring matter with the fluids. He has also observed that at this time the drop, which is compressed to a thin layer between glasses for microscopical examination, is likely to "creep somewhat rapidly backwards and forwards under the cover glass," a movement which, he claims, is like that of a simple amoeba. The progression is in a line with the streaming motion already referred to;—that is to say, there is a point upon the surface of the drop at which the interchange between its contents and its environing liquid is most active, towards which point the internal currents converge, and from which the external currents diverge, thus creating an anterior pole to the drop, and the author himself expresses the belief that "the creeping progressive movements are without doubt in connection with such streamings." In strongly pressed drops several centres of extension currents may arise, and, as the oil then spreads in several directions at once, there is created the appearance of "pseudopodium-like processes," but "such drops show, as was to be expected, no actual forward movement as a whole." The author remarks that "not infrequently a drop of the kind just described is observed to run towards one of the strips of cover-glass employed as supports," which plainly suggests that all of his "creeping" movements may be the result of capillary attraction, when they are not produced by the mere pressure of his compressorium.

As to "growth," Professor Bütschli is not able to present any proof beyond the simple swelling of the drops during the first imbibition of water and solution of the salt crystals entangled in the oil, by which the conversion of the oil into froth is accomplished. In fact all of the processes described are but temporary and are strictly confined to the period necessary to bring about a state of physical equilibrum in each case. Even the streaming movements are known to have continued only from twenty-four hours to a maximum of six days, apparently in proportion to the freedom allowed the drop to carry on the process of interchange, or to the quantity of matter concerned in the operation. In any case, the author admits that "the streams gradually become weaker and weaker, and finally cease," and that "the duration of the extension currents described is, for the most part, relatively short." In this respect, at least, the parallel between oil drops and protoplasm is lacking, for, according to the latest and most generally accepted belief, the one essential characteristic of protoplasm is its never ceasing activity, and it is this very attribute which now needs explanation and to which biologists are devoting the greatest attention. Professor Bütschli's experiments certainly cast no more light on this problem than do the achievements of chemists who have approached close to the synthetic construction of "the physical *basis*" without actually initiating in it the vital processes. As to the apparent similarity between the so-called creeping of his oil drops, and the purposeful and continuous migrations of the protozoa, Professor Bütschli finally admits that his explanation "seems at present feasible only for amoeboid movement in the strict sense, while other modifications of it, especially the formation of the fine pseudopodia of numerous Sarkodina, obtain no explanation." His theory of the simplest amoeboid movement is, however, itself so novel and extraordinary that we cannot but think it needs confirmation quite as much as does the phenomenon which it is intended to illustrate. Our author's belief is, that "by the bursting of some of the superficial alveoli, enchylema is poured out upon the free surface of the protoplasmic body, where it produces a local dimunition of surface tension, and in this way sets up an extension centre together with forward movement." If this theory is ever established upon a basis of actual observation it is difficult to see why the process may not be witnessed as easily in living forms as in artificial foams. On purely speculative grounds there are strong objections to the hypothesis, and some of these have made so powerful an impression upon Professor Bütschli that he is constrained at the last

moment to append a frank confession that they necessitate the admission that the explanation of amoeboid movement brought forward by him "is inadequate." Even on this point, therefore, his experiments have not furnished a tenable theory applicable to free protoplasmic forms. Add this to the author's other admission that in his oil foams "nothing was ever observed of a rotational streaming such as occurs so commonly in vegetable cells," and we are left in wonder as to what possible application his experiments can have to biological problems of any kind.

We have given so much attention to Professor Bütschli's main contention that our space does not permit of a review of his less important arguments. It must therefore suffice to say that his criticisms of the various theories of protoplasmic structure are able and interesting.

The objects of his animadversions are, however, principally those who, like Velten, Brücke and Heitzmann, have held to the necessity of an organization in protoplasm made up of more solid and more fluid parts, the more solid constituting the active reticular structure in which resides the power of contractility, the more fluid being the passive contents of the living meshwork. All that needs to be said on this point is that the theory of Heitzmann is a fair attempt to account for actually observed phenomena in natural organisms, while the speculations of Bütschli do not appear to explain satisfactorily the behavior of even his own creations.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as a proof of good faith.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The Editor will be glad to publish any queries consonant with the character of the journal.

Earth Worms.

The earth worm notes and comments which have been published in recent numbers of *Science* have been of considerable interest to the writer, and this opportunity is taken to offer a few notes of observation, made at various times, bearing on the question of the cause of the appearance of large numbers of earthworms in rainy weather.

While it is not uncommon to read or hear of what are apparently well authenticated instances of "showers" of frogs, tadpoles, and fish, it is very rare to hear of any one who has seen earth-worm showers. Yet among the unobservant, the commonly received explanation of the occurrence of these animals in the large numbers that appear on our city and village sidewalks and pavements, during rain storms, is that they "rain down."

The habitat of the aquatic and amphibious animals makes it possible to accept as true the accounts of falls of such forms, because they might be taken up into the air with the water in which they live by some sudden strong uprush of air, as a tornado, but it is difficult to imagine conditions under which the burrowing earthworm could be raised to a position from which it could "rain down."

The worms which appear during rain can be satisfactorily accounted for, if a reason sufficient to bring them out of the ground can be found. Each square foot of loamy soil has, among other inhabitants, one or more earthworms living in it, so that the grass borders of streets and walks, even in large cities, harbor myriads of these animals and the soft earth in less thickly settled communities hides numbers of them beneath its surface.

Granted, then, the presence of the worms near at hand to sidewalks and pavements, cause adequate to bring them out of the earth during the rain and to make them wander about must be found. An explanation readily suggests itself, from the fact that the burrows of the animals must be full of water when it is raining, and it would seem that they would have to come to the surface or drown, and for a long time the writer was satisfied that this theory explained the appearance of the worms.

The following facts, noted at different times, tend to show that the explanation is not sufficient:

A number of years ago, while preparing some earthworms for use in a zoölogy class, I was washing them in a tank of running water, the source of supply being a small faucet tapping the village mains, the ultimate source being a small river. In the tank, which was of galvanized iron, were several crayfish, a few specimens of Onodonta and other mussels, and some snails. During the washing process, several of the earthworms slipped away into the tank, and they were left there to serve for food for the crayfish. There was no sand or earth in the tank, except a small quantity of sediment which had accumulated from the water and its inhabitants, and this was not over an eighth of an inch deep in the deepest place. Within a short time, all of the animals, except one very large specimen of a species of unio, were taken from the tank, and wishing to keep the unio alive, the water was not shut off, but left running in a small stream through the winter and the following summer. The next fall, having to use the tank for another purpose, the unio was removed and the tank cleaned. When the water was allowed to run out, in the bottom of the tank was found a large and active earthworm. The room was a private one, of which I carried the only key, and there had been no earthworms in it since the previous year, and the opening through which the water entered the tank was only sufficient to admit a slender stream of water, just sufficient to keep up circulation in the tank. The worm was carefully examined to make sure of the identity of the species, and it was permitted to escape. The sediment in the bottom of the tank was largely vegetable in its origin, and was of such character as to furnish abundant food for an earthworm, but was even at the end of the year hardly as deep as the worm was thick. The tank was about a foot deep, and the worm had lived about a year in that depth of water.

A second case came to my notice while collecting crayfish in a small river in this vicinity. The water in the part of the stream where the collecting was done was a little less than knee deep and the stream about forty feet wide. The crayfish hide under water-logged slabs and pieces of bark from the mills above, and to catch them the wood has to be moved. Under a slab in the middle of the stream was found a live and active earthworm, which was not buried in the mud, but lying immediately on the surface of it under the slab. There had been no rain for several days, and it was not probable that the worm had been washed into the stream from the bank. These instances, together with the fact that these animals are frequently abundant in soil that is saturated with water, and the observations and records of similar and more numerous cases of the same sort, noted by Darwin in his work on the "Formation of Vegetable Mould," tend to make it plain that the earthworm is not driven out of its burrow because it fears water.

From these considerations it is probable that still other causes to explain the phenomenon must be sought, but it is not my purpose to offer any theory in explanation. The following facts, however, may suggest a line of approach, along which investigation may be made by those disposed to attempt to work out the problem. If a light tapping be made on the surface of ground inhabited by earthworms, they will come to the top of their burrows, and if the tapping is kept up they will finally crawl entirely out of the ground. The birds are well aware of this fact, and robins, in particular, make use of their knowledge of

it to get many a good meal, striking their beaks against the ground, until a worm shows its head, and then siezing it and drawing it forth. It is also said that the grotesque dances which some wading birds indulge in are solely for the purpose of attracting earthworms to the surface of the ground.

My own attention was attracted to the habit by noticing that a number of worms were wriggling about my feet as I stood talking with a neighbor in his freshly plowed garden. I had been moving about and tapping the soft loam with one foot, and the worms had appeared to find out the cause of the disturbance.

The ability of these animals, in the direction of climbing, is remarkable, and probably explains their occurrence in apparently inaccessible places, such as eave-troughs, etc., although it is not impossible that they are sometimes carried to such places by birds, or even that their eggs are blown to them by the wind and afterwards hatched.

I have seen them climb out of a Mason fruit jar of the quart size, in which there was not over an inch of earth, ascending the reverse curve at the top with as much ease as they did the straight part. In this case they were assisted by a certain amount of moisture on the inside of the jar. The conclusions deducible from the foregoing are:

First, That the worms do not rain down, but come from unpaved ground, near the walks and pavements on which they are found.

Second, That in some cases, at least, they can live for a long time entirely under water.

Third, That they may be attracted to the surface by tapping or striking on the ground.

Fourth, That they climb up perpendicular surfaces easily, even those of glass, if they are moist.

CHARLES A. DAVIS.

Alma, Mich.

Cats Hunting Snakes.

IN a late number of *Science* Mr. D. S. Martin asks for information in regard to the snake hunting habit of cats. It is such a common thing for cats to hunt snakes in this region of country that it seems to be expected of every ranch cat that she, or he, will hunt them. I have often seen my cat bring in snakes from three to four feet long. These are generally what are known as gopher or chicken snakes.

In Lafcadio Hearn's wonderfully magnificent word picture of Martinique ("A Midsummer Trip to the West Indies") he describes the grand forests of tropical vegetation in words that seem to bring them before one and then adds: "The lord of all these is the terrible fer-de-lance, the trigonocephalus, the bothrops lanceolatus, the craspodecephalus, deadliest of all occidental thanatophidia." His description of this snake is fine, and the manner in which it reigns supreme over the mountains, ravines, and forests during the day and the parks, highways and places of public resort at night shows plainly that he is right when he says the king of the island is this terrible snake. But even the king has his conqueror, and though it may be a long quotation I think the readers of *Science* will thank me for giving the words of this great master of language.

"The creature who fears the monster least is the brave cat. Seeing a snake, she at once carries her kittens to a place of safety, then boldly advances to the encounter. She will walk to the very limit of the serpent's striking range, and begin to feint, teasing him, startling him, trying to draw his blow. How the emerald and topazine eyes glow then!—they are flames. A moment more, and the triangular head, hissing from the coil, flashes swift as if moved by wings. But swifter still the strong stroke of the armed paw that smites the horror aside, flinging it, mangled and gasping, in the dust. Nevertheless, pussy does not yet dare to spring; the enemy, still active, has almost instantly reformed his coil; but she is again in front of him, watching—vertical pupil against vertical pupil. Again the lashing stroke; again the beautiful countering; the living death is hurled aside, the scaled skin is deeply torn, one eye socket has ceased to flame. Once more the stroke of the serpent; once more the light, quick, cutting blow. But now the trigonocephalus is blind, is stupefied; before he can attempt to coil, pussy has leaped upon him, nailing the horrible flat head fast to the ground with her two sinewy paws. Now let him lash, writhe, twine, strive to strangle her!—in vain! he will never lift his head: an instant more and he lies still; the fine white teeth of the cat have severed the vertebræ just behind the triangular skull."

He does not say the cats eat them. Probably they do. With us they hunt, kill and eat common snakes. A writer in the Americus (Ga.) *Republican* in March, 1880, tells of a fight between a cat and a rattlesnake, but, though the cat sought the encounter, both animals were killed.

F. A. HASSLER, M.D., PH.D.

Santa Ana, Calif.

Mesabi Iron Range.

IN my paper on the "Mesabi Iron Range," published in *Science*, Feb. 9, I should have given credit to Horace V. Winchell for the rock series, instead of to Prof. N. H. Winchell.

E. P. JENNINGS.

Ironwood, Mich.

Temperature in High and Low Areas.

IN *Science* for April 14, 1893, and again for Sept. 22, I took issue with Dr. Hann, of Vienna, on a single point in his latest discussion of this question. In the *Meteorologische Zeitschrift* for December Dr. Hann again attempts to answer my argument. The original investigation was of 27 maxima and 27 minima of pressure that crossed the Alps from Oct., 1886, to Dec., 1890. In this study, the temperature and pressure at Sonnblick (10,170 ft.) were compared with the same conditions at Ischl (1530 ft.) at the base. This would give an air column of 8640 ft. Dr. Hann found that during the passage of high areas the temperature at Ischl was *higher* than in low areas, and I took the ground that this was directly contrary to the usual, well ascertained law, and hence that this whole exhaustive investigation attempting to prove that in high areas at Sonnblick the temperature is higher than in low areas must be discarded as erroneous.

Dr. Hann now makes no attempt to explain how he obtained such a peculiar result, but claims, first, that my point is a trivial one—"Die von Herrn Hazen citirten Ziffern enthalten nur die triviale Wahrheit, dass es zuweilen bei hohem Barometerstand auch im Winter wärmer sein kann, als bei niedrigem Barometerstand." Second, he shows that in the latter part of his original investigation he proved that the usual law holds in the Alps.

I desire to note one or two points in closing my share in this discussion.

First, I protest against the use of the expression "Barometerstand" in such studies. I called attention to this in 1887 in my first article on this most important theory Dr. Hann had accepted from an investigation of M. Decherows, namely, that at some height in the air the temperature was higher in a high area than in a low area. "Barometerstand" means barometer position or

reading and may have no connection whatever with a high area. There seems to be the utmost confusion in Dr. Hann's writings in which he uses barometer maxima and minima or the above indiscriminately. It is very certain that the whole meteorologic world has understood definite high and low areas, ordinarily called anticyclones and cyclones, in all these expressions.

Second, the point I made is by no means a trivial one, as the following figures from Dr. Hann show. I will take the two colder months, Feb. and March, from his table.

Temperature Fahr. at base of Sonnblick during high and low areas:

	HIGH AREA.	LOW AREA.
Feb.	33.8°	23.4°.
March	39.2°	22.8°.

I submit that temperatures 10.4° and 16.4° *higher* in a high area (anticyclone) than in a low area (cyclone) are not trivial.

Third, Dr. Hann himself shows that the usual law holds in the Alps, for in the latter part of this same paper there is a table giving the temperature in high areas 16°.5 F. and in low areas 35°.4, or a difference of 18°.9 in exactly the opposite direction from that previously demonstrated.

I am inclined to think that these serious contradictions throw a cloud over this investigation, and it is of the utmost consequence that this be explained, but if it is not, then the original contention, that temperature in the Alps is higher in high areas than in low areas, must be abandoned.

H. A. HAZEN.

Washington, D. C.

Meandering Rivers in Missouri.

PROF. WM. B. DAVIS'S letter, in *Science* of November 19, contains much that it suggestive relating to the extent and phases of past denudations over the area of the Ozark uplift. In my letter of July 21, however, to which his is a reply, it was not so much my object to attempt to fix the age of the Osage River, or to define the changes of level that have taken place, as it was to raise the question whether a past base-levelling was necessary to explain the meander phenomena of this and the other rivers referred to. I there undertook to explain how the sinuosities of such streams might develop in a country which was not base-levelled. Mr. Davis, with characteristic candor, accepts this as an "important correction" to his explanation. Briefly, and expressed in general terms, the view advanced was: that, under certain conditions of declivity and stratigraphy, streams will acquire trenched meandering courses irrespective of whether the country be a flat plain or not, and irrespective of whether the lines of flow at the beginning of these conditions were decidedly sinuous or only gently curving. In any case, the radius of *developed* meanders will, of course, be proportional to the volume of the river.

This conclusion seems to follow logically from the premises that all rivers exert a sapping as well as a corrading action; or, in other words, that they tend to erode laterally as well as vertically. To produce these special results it is necessary that the declivity be not so great that lateral wear become altogether insignificant as compared with vertical wear; or that stratigraphic conditions be not such as to entirely thwart these tendencies

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of running water. In a strongly flexed region, for instance, the drainage is largely controlled by the attitude of the rocks. A country of horizontal strata of moderate resistance, such as those of the Ozark plateau, is particularly favorable to the development of a swinging course. Where soft and hard beds, like shales or limestones and cherts, alternate, we can readily conceive how a stream of comparatively rapid fall may move or expand its meanders considerably while cutting only a slight depth through underlying resistant beds. Did time and space permit it would be interesting to elaborate further and to trace the effects of other modifying conditions. Without being prepared at present to express final conclusions, it seems to me probable, however, that the presence of such streams as the Osage over the Missouri-Arkansas plateau can be assigned to local conditions of declivity and stratigraphy.

Whichever hypothesis be advanced it is, of course, necessary for its acceptance that other facts of the geological history of the region be reconcilable with it. As I view the question at present, such reconciliation seems more readily effected on the hypothesis I have advanced, than on Professor Davis's. The exceptions I took to his, that the country had been base-levelled in Tertiary times, are not objections against mine. But, whether Mr. Davis be right or not as to the volume of erosion (leaving out of consideration the resultant forms) and as to the earth movements that have taken place since Paleozoic time, the explanation which I offer stands equally good.

I do not mean by this, however, to beg the questions of the extent of Mesozoic denudation and of the oscillations which have taken place since the Paleozoic period. There have undoubtedly been changes of levels; such were necessary to bring the Cretaceous and Tertiary rocks of the Mississippi embayment to their present altitudes; but I do not think the differential movements within the limits of Missouri have been very great. While the seas existed in which the post-Paleozoic deposits of Kansas and Colorado were laid down, the drainage of a part of Missouri probably flowed in that direction. With the uplift of the western area, certain readjustments of drainage must have taken place over Missouri. When I stated in my last letter that the sculpturing of the topography must have been uninterruptedly in progress from the end of the Paleozoic to the present time, I meant that Missouri had been essentially a land surface since that time. Probably the larger features of its drainage system were blocked out at the beginning of this period of emergence. This statement is not at all opposed to the idea that changes of level or readjustments of drainage took place during that period. Just what was the exact sequence of events, or the nature of the changes, I do not feel prepared to say. More critical field studies, better knowledge and more careful consideration of the geological history of surrounding areas is necessary before anything like the full story can be told. With such knowledge as we have, however, I am not inclined to accept the hypothesis of a wide base-levelling such as is required, if all of the sinuous streams of this region are assigned to that cause; and this especially when another hypothesis seems adequate to explain the phenomena in question.

ARTHUR WINSLOW.

Office State Geological Survey, Jefferson City, Mo., March 5, 1894.

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CONTENTS.

THE IMPORTANCE OF STRUCTURAL DETAILS IN THE STUDY OF PLANTS. W. W. Rowlee . . . 155

NATIONAL PARK PROTECTION. Geo. Bird Grinnell 156

THE SEMBLING OF A LARGE NATIVE MOTH, TELEA POLYPHEMUS. H. Garman . . . 156

IS GRANITE EVER METAMORPHIC? C. Callaway . 157

THE EMPLOYMENT OF DISEASE-CAUSING MICROBES FOR THE DESTRUCTION OF FIELD MICE, MOLES AND SIMILAR VERMIN. Gerald McCarthy . . 158

SCIENTIFIC WASHINGTON 158

GOLDEN SANDS OF THE PACIFIC COAST. Clarence M. Buel 159

THE SELF-PURIFICATION OF RIVERS. Charles V. Chapin 160

LETTERS TO THE EDITOR:

PALÆOLITHIC POTTERY. Henry W. Haynes . 161

MR. MAC DOUGAL AND POISONING FROM CYPRIPEDIUM SPECTABILE. L. H. Pammel . . 162

A MINIATURE WATER LILY. Jas. M. Macoun . 162

THE SWASTIKA CROSS. G. Frederick Wright . 162

NATURE STUDY IN THE SCHOOLS. Lucy A. Osband 163

A BRILLIANT AURORA. G. E. Culver . . . 163

THE DURABILITY OF THE POISONOUS PROPERTY OF POISON IVY, RHUS RADICANS L. (R. TOXICODENDRON L.). E. E. Bogue 163

A NEW DICOTYLINE MAMMAL FROM THE KANSAS PLIOCENE. S. W. Williston 164

BOOK REVIEWS 164

NOTES AND NEWS 166

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First inserted June 19, 1891. No response to date.

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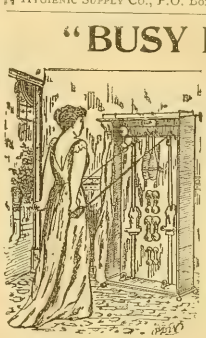

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NEW YORK, MARCH 23, 1894.

THE IMPORTANCE OF STRUCTURAL DETAILS IN THE STUDY OF PLANTS.

BY W. W. ROWLEE, ITHACA, N. Y.

IF there was any one thing more than another that led the ancient herbalists into serious and often amusing errors in regard to plants, it was their ignorance of the structure of vegetable tissues. Their minds were not in a condition to be attracted by natural phenomena, and, further, they were without lenses and other appliances which are so indispensable as aids to workers of the present day.

It is, moreover, but recently that some important advances have been made in methods of treating tissues in order that their structure may be more thoroughly and exactly studied. With the exception of those which are lignified or sclerenchymatous, all vegetable tissues are too soft and yielding to be cut even with the sharpest knife without undergoing displacement and distortion, and especially is this true of that part of the tissue most important of all from a physiological point of view, i. e., the protoplasm. In its normal condition in the vegetable cell, protoplasm resembles in texture and consistency the white of an egg. No one would expect to cut this substance in its natural condition into sections to be examined with a microscope. The cell-walls also are displaced when unfixed tissue is cut, especially if the tissue be from delicate organs. If fresh material could be cut and examined without any distortion it would be highly desirable to do so, as all parts would be unchanged, but not only is this impracticable on account of the firmness of the tissue, but, moreover, certain parts are in nature colorless and must be stained before they can be seen.

Fixation of tissues consists in hardening and preserving the pliable and perishable parts of tissues, especially protoplasm and its primary modifications. This is accomplished by replacing the water in the tissue by some preserving fluid. The tissue must be killed immediately, and the elements must remain *in situ* through the process of infiltration if the fixing is properly done. Professor Gage in his "Histology" recommends picric-alcohol (25 p. c. alcohol + .2 p. c. picric acid) for fixing tissues, and it has given us entire satisfaction so far as fixing material is concerned. The stain made by picric acid, however, is not altogether satisfactory. Professor Campbell (*Bot. Gaz.* Feb., 1891) found chromic acid very effective as a fixing agent in his work upon the delicate tissues of fern prothallia. We have been satisfied with results attained from using alcohol, always being careful at first to apply only sufficient to kill the tissue and then gradually to increase the strength of alcohol until the tissue is completely dehydrated. The most satisfactory method of accomplishing this we have found is by the modification of Schultze's apparatus devised and described by Professor Thomas (Proc. Am. Micro. Soc., 1890). If the fixing has been properly done all the tissue elements will be *in situ* and normal except in so far as the alcohol produces changes. The tissue after fixing has been accomplished instead of being flexible is exceedingly brittle and must during succeeding manipulations be handled with the greatest care. As a general rule it is safer to pour pieces of delicate tissue from one vessel to another rather than to handle them with forceps. In this condition, protoplasm and cell-walls are firm enough to withstand the knife without displacement, providing proper support is afforded.

This support may be gotten by infiltrating the tissue with some liquid which under changed conditions will become solid. Here, too, the agents used should be such as modify the tissue as little as possible. Paraffin and collodion have been most used. Both will penetrate not only the intercellular spaces and cell cavities but will also infiltrate into the cell-walls and protoplasm, preventing the former from tearing and holding the nucleus and plastic bodies of the latter in position during sectioning. The effects of alcohol and other reagents upon tissues should be determined carefully by experiment, and such changes as occur should be considered before conclusions are drawn.

The importance of exactness in structural studies can scarcely be over-estimated. Confirmation or modification of new systems of classification (and there are plenty of them at the present time) must depend for their permanency quite as much upon accurate observation of structural details as upon the ingenuity of any systematist. A single illustration from a discovery made in our laboratory may not be inappropriate. The nodding bidens (*Bidens cernua*) differs from its congeners of the northeastern United States in having the hypocotyl of the embryo in the seed before germination possessed of large and numerous intercellular spaces. The occurrence of large intercellular spaces in an embryo is of comparatively rare occurence and is probably of assistance to the plant in aerating its tissues during germination. This seems the more probable when one considers that the first structural modification attending germination is the enlargement of the intercellular spaces. In species in question the provision of intercellular spaces has been provided before germination. If this organ had been cut fresh the knife would have displaced the cells so as to render uncertain the relation of the cells and spaces.

Fixed and properly imbedded, the cells retain their normal condition and position; the intercellular spaces are just as they were in the living plant.

The embryos of other plants afford quite as distinctive structural characters and often as interesting functional adaptations.

The correct interpretation of tissue modifications in plants has led to the conclusion that plant diseases may be caused by improper conditions of moisture, etc. Dropsy in plants has been caused by too great activity in the root-system of the plant, and thereby unbalancing the equilibrium between absorption and transpiration. This disease was first discovered by a careful examination of the structural details, and the fact that the disease was so discovered leads to the opinion that much light may be thrown upon the diagnosis and cure of plant diseases by a careful study of the minute structure of the plant.

NATIONAL PARK PROTECTION.

BY GEO. BIRD GRINNELL.

THE recent slaughter of twenty or more of the National Park buffalo has excited widespread comment and calls attention anew to the fact that, although the Yellowstone Park was established twenty-two years ago last March, no law for its protection has ever been enacted.

The organic act by which the Park was set aside says that the Secretary of the Interior shall make rules and regulations for its protection and the preservation of its natural wonders, but nothing in this act nor in any other provides any form of government, gives jurisdiction to any court, appoints any law officers or defines and fixes penalties for any crimes or misdemeanors committed within the boundaries of the reservation.

There are now pending before Congress—in the House of Representatives and in the Senate as well—several bills which provide for the cutting off from the area of the Park about 1,200,000 acres of land, largely forest covered, and one or two which contain some needed government and police provisions. It is of the utmost importance that one of these last named bills should be passed. No matter how efficient and energetic the commander and his troops, to whom the care of the Park has been given, it is impossible for him efficiently to protect it so long as no punishment awaits the man who violates the regulations established by the Secretary—shoots down the buffalo or fires the forests. As things exist to-day no such punishment can be meted out. Government scouts may capture a poacher red-handed, having just slain some of America's largest wild animals, but it is certain that soon after the prisoner has been brought to the guard house, he will be set free, because no law takes cognizance of his crime and provides that he shall be given a trial and punished if found guilty. The Yellowstone Park has been set apart from the states in which it lies, and put under the authority of the Secretary of the Interior. The laws of those states, therefore, do not apply to crimes committed within its borders, and Congress has given the Secretary of the Interior no authority to punish crime.

No class of men comprehend better than the readers of *Science* the importance of preserving the Yellowstone Park and all it contains as nearly as possible in a state of nature. Nor is there any class among our population who can exercise more influence toward inducing Congress to pass the much needed laws. It is earnestly to be hoped that each reader of *Science* will do his part toward bringing influence to bear on Congressmen and Senators, so that a proper police bill may be passed for the Park.

Some of the objections to the passage of the segregation bill are that such segregation would establish a very bad precedent, since if one corner can be cut off to-day another may be cut off to-morrow, and by continual whittling the area of the Park may finally be reduced to nothing. Segregation by reducing the area of the Park brings skin hunters nearer to the herds of wild game and to the forests, and increases the danger to both. Segregation also absolutely destroys large herds of wild game and considerable areas of forests at present existing in the country proposed to be segregated. Segregation reduces the area of the National Park by nearly 1,200,000 acres, restoring to the public domain land which is utterly valueless for purposes of settlement. It is high, rough, mountain land, unfit for agriculture or stock range, overgrown with timber which is at present too far from a market to be of vulue, and probably without any mineral deposits that are worth working. This land will be vastly more useful as a forest reserve than it can be for any other purpose.

THE SEMBLING OF A LARGE NATIVE MOTH, *TELEA POLYPHEMUS*.

BY H. GARMAN, LEXINGTON, KY.

THE collection of males of our larger Bombycid moths has sometimes been practised by confining newly matured females so that the males attracted could be secured, but I am not aware that it has been made a matter of careful observation and record, or that the source of the attracting secretion has been made out. I have often secured a limited number of male *T. polyphemus*, and of *Platysamia cecropia*, by this method, but a recent experience is, for myself, out of the ordinary, and may be worth reporting.

In the latter part of July, 1893, a fine female *T. polyphemus* emerged in one of my breeding cages. She came from her cocoon in the afternoon, and by night her wings were pretty well expanded. I thought when I went home at five o'clock that her wings were not sufficiently firm for a good cabinet specimen, and so she remained in the cage till next day. In the evening of the following day cage and moth were taken to my home, and mosquito-bar being tacked over the front of the cage the latter was placed in the open window of my bedroom. In the night I was awakened by the fluttering of wings against the window and curtains, and getting up secured the two first males that had appeared. It was then just 1.30 A. M. From this time till daylight the males continued to come, sometimes two or three arriving about the same time, but oftener one at a time. All that appeared were captured, and in the morning I found I had twenty males, most of them nearly or quite new in appearance.

The next night the same story was repeated, the first moths appearing at about half-past one, and the rest scattering along between this and morning. This night I secured twenty-three males.

The third day was rather cool, and the night following was cool and breezy. The female had now laid most of her eggs. No males appeared. I thought no more would come, but concluded to leave the cage in the window a few nights longer.

The fourth night five males appeared, and on the sixth, four were secured. In the former case the first moth appeared at fifteen minutes of one, and in the latter at two o'clock.

On the sixth night no males were secured, and the

female having placed all her eggs on the sides of the cage, it was decided to terminate the experiment.

As a result I had fifty-two males, all attracted to a single female, in a locality in which the species is not more than ordinarily common. All arrived in the latter half of the night, indicating either that the sense of smell in the males is extraordinarily acute, and that they travel long distances to find the female, or else that it is their habit to be abroad only after midnight. I have no very reliable data upon which to base a conclusion on these points. The scent glands of the female are to be looked for on the under side of the abdomen, where such organs have already been discovered in certain smaller members of the same family of moths. The male organs of smell are doubtless the conspicuously branched antennæ.

IS GRANITE EVER METAMORPHIC?

BY C. CALLAWAY, D.SC., F.G.S., WELLINGTON, SALOP, ENGLAND.

It is not so many years since it was commonly believed that granite was frequently of metamorphic origin. Numerous cases were quoted of a gradual passage between sedimentary strata and granite; and, as it was held to be incredible that a sediment could be produced from granite, it was inferred that the granite was an altered form of the sediment. The present writer shared in the popular belief, and in several papers written on the more ancient of the Archæan rocks of Great Britain, he assumed that the granitic masses called "Dimetian" and "Malvernian" were metamorphosed stratified rocks. But scepticism soon began to creep in. Case after case broke down on examination, until, within the area of the British Islands, he was unable to find a genuine case of a passage between a sediment and a granite. A few examples will here be given.

In North Wales, several cases were alleged. At Twt Hill, in the town of Caernarvon, granite was said to pass into a quartzose conglomerate. The gradations did indeed appear to be perfect in the field, but the microscope proved that the naked eye was not a reliable guide. It was shown that the granite passed into the con-glomerate through the intermediate form of arkose, and even the authors of the metamorphic theory voluntarily surrendered it. A second locality was in central Anglesey. Here a band of granite strikes across the island, trending in the same direction as the adjacent sedimentary and schistose rocks. On one side of it lies hälleflinta, passing into schist. The granite has been described as "Dimetian," and the hälleflinta as a younger formation called "Arvonian." The writer has given prolonged attention to these rocks, and has discovered localities where the granite is seen to send veins into the hälleflinta. The granite must, therefore, be of less antiquity than the hälleflinta, and of eruptive origin. In other parts of Anglesey, certain sediments of Ordovician age have been supposed to be here and there converted into granite; but the most recent investigation of these rocks does not confirm this hypothesis.

In England the facts are similar. The schistose and gneissic rocks of the Malvern Hills have been described as metamorphic Cambrian strata. At a later period they were referred to the Laurentian system, being still regarded as altered sediments. The present writer has been studying these rocks for several years, and has described them as exclusively of igneous origin. The oldest varieties are diorites, and into these there have been intruded granites, felsites, dolerites, and other diorites. Subsequently to consolidation, these masses have been subjected to enormous pressures, which have produced shear-zones, in which the eruptive rocks have been converted into various gneisses and schists. A very good summary of the writer's papers on these rocks has recently (February 9, 1894) been given in *Science* by Prof. J. W. Redway. Some of the conclusions are still under discussion; but the eruptive origin of the diorites and granites has been admitted by all those who have reviewed the work in the field.

The Hebridean gneisses of Scotland have recently been examined by the Geological Survey of Great Britain. The conclusion of the Director-General (Sir A. Geikie) is that "after a most careful search in these rocks, not a vestige have we yet found of any unquestionable sedimentary material." The writer has given some attention to alleged examples of metamorphic granite in Ireland. In County Donegal a great mass of granite rises amidst quartzites, limestones, and schists, and it has been affirmed that there is a gradual passage between the schists and the granite. The writer examined the junction of the two kinds of rock on both sides of the granite mass, and found the clearest proof of igneous intrusion. At some points the granite veins are seen to run into schists, and to branch in the ordinary manner. Elsewhere the granite is in contact with limestone, and has altered it, producing in it an abundance of garnets as well as some lime-augites.

In western Galway there is another alleged case of the passage of sedimentary rocks into granite. These, also, the present writer has examined. He has found clear evidence of breaks between the sediments and the schists into which they were supposed to pass. He has also ascertained that the "metamorphosed conglomerates" adduced in proof of the sedimentary character of the Galway schists are mixtures of schist, granite and diorite, or of two of them. A foliated structure sometimes appearing in the granite was seen to be due to regional pressure, and not to sedimentation.

A third case, occurring south of Wexford, was also investigated. The writer came to the conclusion that the granite of the Carnsore district nowhere passed into crystalline schists, and that the schists were sharply separated from the sedimentaries by faults. It is possible that some of the schists have been formed from igneous rocks, but, if so, they belong to a different period from the Carnsore granite, which shows no signs of foliation.

In adducing these examples the writer infers no conclusion wider than the facts. He does not deny that there may be such a thing as metamorphic granite; he merely points out that certain alleged proofs have broken down on examination. Nevertheless, the results of the most recent work by other geologists have tended to confirm his investigations, and to suggest extreme caution in accepting other supposed cases of a passage between granite and stratified rocks.

One cause of error in the past has been the assumption that a banded structure was always the result of sedimentation. This view is now exploded, and need not be dwelt upon here. It has recently been shown that even rocks with all the appearance of a banded grit may be of igneous origin. The writer has described a very interesting case of this kind in the Malvern Hills. A granitoid diorite is crushed and decomposed. The hornblende passes into chlorite and iron oxide, which are interlaminated with finely comminuted feldspar. Both in the field and under the microscope the rock has the appearance of a true sediment. Yet it may be traced without a break into the diorite on one side and into a mica-gneiss on the other. In the old days this grit would probably have been regarded as a conclusive proof that the whole series was of sedimentary origin.

THE EMPLOYMENT OF DISEASE-CAUSING MICROBES FOR THE DESTRUCTION OF FIELD MICE, MOLES AND SIMILAR VERMIN.

BY GERALD M'CARTHY, N. C. AGR. EXPT. STATION.

THE loss annually caused by field mice, moles, gophers, hares and other rodents, is in the United States an indefinite quantity, but must in the aggregate amount to several millions of dollars. In California and Colorado the jack-rabbit, *Lepus Californicus*, and sage rabbit, *L. artemisia*, are very serious pests, while in the eastern states *L. sylvaticus*, the cotton tail, and *L. palustris*, the swamp coney, are depredators in grain shocks and growing crops.

The gophers, *Geomys*, and other genera, are very destructive in the grain fields of the arid West. The damage wrought during winter by gnawing mice and hares in the orchards of the eastern states is a matter of no small consequence to fruit growers, and nursery-men and gardeners raise a continuous howl against the ground mole.

The damage caused in Australia by the introduced rabbit is enormous—almost exceeding belief. In Europe the worst pests of the rodent family are the common field mice, *Arvicola arvolis* and *Mus sylvaticus*, called in France *campagnols* and *mulots*, respectively.

How to destroy these vermin on a large scale and over wide areas, without destroying at the same time useful animals, has recently engaged the attention of many European scientists. In the United States the use of poisoned grain, and more recently of carbon bisulphide for the burrowing species, has given the most satisfactory results, but in various countries of the Old World the employment of pathogenic bacteria for this purpose has given a gratifying success.

In a paper recently presented to the French Academy by M. Jean Danysz, a destructive, spontaneous epidemic among these animals in the Commune of Charny is described in detail, and experiments reported to show that while highly contagious and fatal to all small rodents, it is quite innocuous to cats, dogs, fowls, domestic animals and human beings. The specific bacillus was isolated by the culture method and was subsequently employed on a large scale to destroy the vermin infesting an area of about seventy-five hectares. The whole number of rodents infesting this space was calculated at from 10,000 to 30,000,—*Arvicola arvolis* being in the majority.

The process of infecting the field with the pathogenic germs was substantially as follows: The contents of ten dozen of gelatin culture tubes containing the bacillus were dissolved in fifty litres of water, and in this was soaked about 80,000 cubes of bread of about 1 c.c.m. The bread was then scattered throughout the field, a morsel being placed near every hole showing recent traces of an occupant. The operation occupied twenty persons two hours daily, from four to six P.M., for three consecutive days. The total cost of the treatment amounted to about 3 1/2 francs per hectare, or about thirty cents per acre. Within three days after the distribution of the infectious bread, sick and dying mice were plentiful in the field, and autopsies of several showed the presence of the microbe in their blood. The bread was distributed over the infested fields September 29 *et seq.*, and on October 15 scarcely a living mouse could be found in the infected area, though abundant enough in neighboring non-treated fields. Opening the burrows of the rodents showed their galleries to be filled with dead mice.

This same process was tried in several other departments of the republic, and always with similar success, insomuch that the author concludes that in this microbe farmers whose fields are infested by gnawing rodents have a simple, inexpensive and certain remedy.

The identification of the bacillus is not given in the paper referred to, but is promised in a future communication to the Academy. The author states that it is very similar to the bacillus of duck cholera, but not identical, nor are ducks or other fowls susceptible to the disease.

SCIENTIFIC WASHINGTON.

THERE are now seven associated scientific societies in Washington, having a combined membership of 1524, comprising 1138 persons. These societies and their membership are as follows:

Anthropological, 205; Biological, 190; Chemical, 102; Entomological, 38; Geographic, 619; Geological, 137; Philosophical, 233. These numbers indicate the active resident membership: there are in addition 472 members, a few honorary, the remainder active, though residing elsewhere.

These organizations include many men eminent in science and in official life. Among officials are Hon. H. A. Herbert, Secretary of the Navy; Hon. J. Sterling Morton, Secretary of Agriculture; Major J. W. Powell, Director United States Geological Survey; T. C. Mendenhall, Superintendent United States Coast and Geodetic Survey; Professors S. P. Langley and G. Brown Goode, Secretary and Assistant Secretary of the Smithsonian Institution; Col. Marshall McDonald, Commissioner of Fisheries; Prof. Simon Newcomb, Superintendent Nautical Almanac; Dr. Frank Baker, Manager National Zoölogical Park; Prof. W. J. McGee, in charge United States Bureau of Ethnology (who has the unique distinction of being a member of all seven societies); Prof. M. W. Harrington, Superintendent Weather Bureau; Prof. W. T. Harris, Commissioner of Education; Mr. A. R. Spofford, Librarian of Congress; Prof. John R. Proctor, President Civil Service Commission; General A. W. Greely, Chief Signal Officer; Surgeon-General George M. Sternberg; Dr. John S. Billings, of the Army Medical Museum; Dr. C. W. Dabney, Assistant Secretary of Agriculture; Dr. B. E. Fernow, Chief of Division of Forestry, Department of Agriculture; Professors Eastman, Hall and Harkness, of the United States Naval Observatory, and many other prominent officers of the Government.

Congress is represented by Senators Manderson, Vilas, Perkins, Squire, and Wilson, and Representatives Baker, Belknap and Stevens.

From the army and navy are many officers whose names are well known, among them General S. V. Benét, General J. C. Breckinridge, General T. L. Casey, Commodore O. C. Badger, Chief Engineer George W. Melville, Dr. J. Mills Browne, Dr. G. H. Beyer, Dr. N. L. Bates, Captain W. T. Sampson and Captain Rogers Birnie.

Every branch of science is represented in these societies, and among many distinguished names a few may be found that are eminent in more than one sphere of research. Here is Prof. Lester F. Ward, who is not only a noted paleobotanist, but a profound student of sociology, and the author of "Dynamic Sociology," "The Psychic Factors of Civilization" and other works; also that of Mr. W. H. Holmes, who is known not only as a geologist and archæologist, but also as an artist; and that of Mr. Henry Gannett, chief topographer of the United States Geological Survey and author of numerous sociologic and economic papers, including a recent book entitled "The Building of a Nation."

Among geologists are Professors G. K. Gilbert, S. F. Emmons, Arnold Hague, George F. Becker, J. S. Diller,

and Bailey Willis, son of Nathaniel P. Willis, the poet and littérateur.

Among palæontologists are Dr. W. H. Dall, Dr. C. A. White, Mr. C. D. Walcott and Mr. Robert T. Hill.

Among chemists are Professors F. W. Clarke, H. W. Wiley, R. B. Warder, and C. E. Munroe, Dr. J. M. Toner, Mr. W. F. Hillebrand and Mr. T. M. Chatard.

Biological science is represented in all its branches—botany by Mr. George B. Sudworth, Mr. F. V. Coville, Mr. W. R. Smith, Dr. Erwin F. Smith, Mr. B. T. Galloway and Mr. F. H. Knowlton; entomology by Prof. C. V. Riley, Mr. L. O. Howard, Mr. W. H. Ashmead and Mr. George Marx; ichthyology by Prof. Theodore N. Gill, Dr. Tarleton H. Bean, and Mr. Richard Rathbun; ornithology by Mr. Robert Ridgway, Dr. Elliott Coues, and Mr. H. W. Henshaw; mammalogy by Prof. F. A. Lucas, Mr. C. Hart Merriam and Mr. F. W. True.

Professors Cleveland Abbe and F. H. Bigelow, meteorologists, are enrolled, and Messrs. H. M. Wilson and F. H. Newell, whose work in the arid West upon problems of irrigation has given them prominence.

Among anthropologists are Colonel Garrick Mallery, Dr. Robert Fletcher, Prof. O. T. Mason, Mr. James C. Pilling, Mr. Thomas Wilson, Mr. F. H. Cushing, Drs. Cyrus Thomas, J. Owen Dorsey and A. S. Gatschet, Captain J. G. Bourke and Mr. James Mooney.

Outside the sphere of technical science many distinguished names appear in the list of members. Here are the venerable Alexander Melville Bell and his son, Alexander Graham Bell, the inventor of the telephone.

Education is represented by Dr. James C. Welling, President of Columbian University, Prof. W. B. Powell, Superintendent of the Public Schools of Washington, President J. E. Rankin, of Howard University, and President E. M. Gallaudet, of the National College for the Deaf.

Literature and journalism are represented by Mr. Henry Adams, the historian, Mr. George Kennan, Mr. William E. Curtis, Mr. C. S. Noyes, Mr. T. W. Noyes; Mr. S. H. Kauffman, Mr. H. L. West, Mr. H. B. Macfarland, Mr. Harry Godwin, Mr. W. A. Croffut, Mr. E. B. Wight, Mr. Henry Farquhar, Mr. C. R. Dodge, and Mr. Clifford Howard.

Other well-known members are Mr. Gardiner G. Hubbard, Mr. B. H. Warner, Mr. John Tweedale, Dr. Swan M. Burnett, Prof. A. H. Thompson, Prof. Gilbert Thompson, Dr. R. W. Shufeldt, Dr. Cyrus Adler, Rev. Teunis S. Hamlin, Rev. G. M. Searle, Dr. Joseph Pohle, Rev. J. G. Hagen, Dr. A. F. A. King, Dr. L. C. Loomis, Mr. John Joy Edson, Rev. J. Macbride Sterrett, Mr. William B. Taylor, Mr. Edward Clark, Prof. H. L. Hodgkins, Dr. Theobald Smith, Dr. D. E. Salmon, Mr. Henry Ulke, Mr. J. Stanley Brown, Major William H. Webster, Mr. A. B. Johnson, Dr. H. C. Yarrow, Mr. C. J. Bell, Mr. Edwin Willits, Mr. W. A. De Caindry, Mr. J. Ormond Wilson, and Mr. W. B. Chilton.

Among ladies enrolled are Mrs. Caroline H. Dall, Miss Alice Fletcher, Miss Kate Foote, Mrs. J. M. Lander (who will be remembered by old play-goers as Miss Jean Davenport), Dr. Anita Newcomb McGee, Mrs. E. R. Scidmore, Miss Sara A. Scull, Mrs. M. C. Stevenson, Mrs. L. O. Talbott, and Miss Haidee Williamson.

Meetings of the societies are held monthly or semi-monthly from October to May at the Cosmos Club, at Madison Place and I Street, and at each meeting two or more papers are usually read and discussed.

Most significant is the extent of the out-of-town membership of these societies, including some of the best-known scientific men in the country, among them Prof. W. O. Atwater, of Wesleyan University; Dr. F. Bascom, Ohio State University; Dr. J. C. Branner, Leland Stanford University; Prof. T. C. Chamberlin, Unive Chicago; President John M. Coulter, Indiana Univ Dr. Thomas Craig, Johns Hopkins University; W. R. Dudley, Leland Stanford University; Pr Daniel G. Gilman, Johns Hopkins University; Prof. E. L. Greene, University of California; Prof. E. S. Holden, Lick Observatory; Prof. E. S. Morse, Peabody Academy of Science; Prof. H. S. Pritchett, Washington University, St. Louis; Prof. I. C. Russell, University of Michigan; Prof. H. M. Seely, Middlebury College, Vermont; Prof. D. P. Todd, Amherst, Mass.; Prof. Winslow Upton, Brown University, R. I.; Prof. C. R. Van Hise, University of Wisconsin; Prof. George H. Williams, Johns Hopkins University; Prof. H. S. Williams, Yale; Prof. Alex. Ziwet, University of Michigan; Prof. J. E. Whitfield, Philadelphia; Dr. Washington Matthews; Major C. E. Dutton and Mr. Charles Nordhoff.

The constant increase in the number of this class of members is an indication that Washington is rapidly becoming a national centre of scientific thought.

GOLDEN SANDS OF THE PACIFIC COAST.

BY CLARENCE M. BUEL, E.M., ST. PAUL, MINN.

THESE auriferous deposits denominated "Black sands" occur at intervals from Takutat Bay, some 250 miles north of Sitka in Alaska to Santa Cruz Bay, California, and have been worked for many years with primitive appliances, sluice box and pan, the gold being fine flake or flour, less than twenty-five per cent being saved. These deposits already mined, milled and on the dump, ready to work, contain a sufficient quantity of gold to more than pay the national debt, *could it be saved*, but the prospector finding two hundred colors in his pan, little thinks that the color visible to the naked eye is but the 1,000,000th part of a grain, finds it so alluring that he at once rigs up a rough sluice box, and often sends a sample to an assayer who gives him returns from $5 to $40 per ton, wonders that he seldom makes more than $4 per day, though other methods have been pursued in attempting to separate the gold from the sands too numerous to relate. Accompanying the gold is found platinum and nearly all the platinoid metals. Chlorination has been tried without success, and the cyanide process (McArthur-Forrest patent) proved a failure, the reason chiefly being that the magnetic iron of which these deposits are largely composed converts the cyanide of potassium into a ferro-cyanide, and the zinc used in precipitation rendered inert by reason of its speedy oxidation in the humid saline atmosphere to which it must needs be subjected. On the Oregon coast, at the mouth of the Coquille, the camp of a thousand miners a few years since is now reduced to a single miner. There are old beaches miles back from the present beaches, with beds several feet in thickness, rich in gold, inexhaustible in extent, unworked now and awaiting some method by which the precious metal may be extracted. This state of affairs exists at Gold Beach, Port Orford, Yaquina Bay, Peterson's Point, and over one hundred other localities. Yet each year sees its quota of Chinese working in their crude manner and paying a royalty of $1 per foot for the privilege. The magnetic iron forms nearly 40/100 and is a mixture of the protoxide and sesquioxide of iron, having 72 parts metallic iron to 28 of oxygen. It is quite hard and scratches glass; strongly magnetic, it is the same as the lodestone, excepting that the latter possesses polarity. It is found in nature disseminated through granite, gneiss, mica, slate, syenite, hornblende slate, chlorite slate and limestone, and is suitable for making the finest quality of steel. Zircon is also found, though too small to be noticed except mineralogically.

HE SELF-PURIFICATION OF RIVERS.

BY CHARLES V. CHAPIN, M.D., SUPERINTENDENT OF HEALTH, PROVIDENCE, R. I.

A GREAT deal has been said and written about the self-purification of rivers, and both the advocates and opponents of the theory that rivers readily purify themselves have taken a very firm stand in the matter. The question, however, is not one which is easily settled. A great many factors must be taken into consideration before we can reach a just conclusion. The question of dilution is an important one. A polluted stream may apparently become purified when in reality there is simply a dilution owing to the addition of pure water either from tributaries or from springs. On the other hand a river may apparently continue without showing any signs of improvement, the improvement being masked by the addition of pollution at various places. It is very seldom that in these discussions this factor has been taken into account and more rarely still that actual measurements have been made, for it is no easy matter to do this. In the first place the amount of water entering the stream between the two points where the tests are made must be approximately known, whether it comes from springs or tributaries. Then the character of this addition must be known, for in most cases the water of tributaries contains very appreciable amounts of pollution.

Another difficulty is the collection of samples. It is evident that if samples are taken from different stations on the same day and hour the sample from the lower station will not by any means necessarily represent the water at the upper station. And even if allowance be made for the flow of the river, it would be extremely dangerous to assume that the water passing the lower station at the calculated time was really the same as that passing the upper station. Yet this method of taking samples at different times should in all cases be followed, though it is by no means the invariable custom.

Another point to be borne in mind is in regard to the chemical analysis of the water. Tests should be made upon the water both before and after filtration through filter paper. In estimating the free ammonia we must take into consideration also the oxidation of albuminoid into the free and the escape of the latter into the air. It is very seldom indeed that all these factors have received due consideration. Perhaps the most careful study of the chemical self-purification of rivers has been made upon the Blackstone by the Massachusetts State Board of Health. A large number of samples were taken with much care during a period of several years, and allowance was made for the addition of natural impurities by tributaries. No allowance was made for the addition of sewage impurities by tributaries, but from a study of the chlorine contents it can fairly be assumed that the amount is small. The first sample was taken just below Worcester, which is the point of pollution, and the last below Millville, twenty-three miles below. The average of all the tests showed a diminution of free ammonia from 1728 to 1299 parts, of albuminoid ammonia from 826 parts to 382, an increase of nitrogen as nitric acid from 218 to 457 and a diminution of total nitrogen from 3000 to 2156. There has evidently then been a very considerable improvement as regards the organic contents of the water, and this notwithstanding a slight addition by tributaries not allowed for. How much of this improvement is due to sedimentation it is impossible to say, but the increase of nitrates shows that it is largely at least due to a true oxidation. Other observers on other rivers have obtained different results, as Percy Frankland from the Thames and Ure, but he does not appear to have taken sufficient account of the addition of pollution by tributaries. On the whole the work of the Massachusetts Board is the most thorough published, and from it we can fairly assume that in a river moderately polluted there is in the course of a few miles a very considerable destruction of dissolved organic matter by oxidation, as well as loss of solid particles by subsidence.

The aeration of the water of rivers in falling over dams and natural obstructions has been supposed to exert an important influence in purification, but this supposition is not correct; for while dissolved oxygen is necessary for the working of certain purifying changes, an excess of oxygen, introduced by however so efficient aeration, has been shown not to extend such process. Careful experimenting in the artificial aeration of water by the Massachusetts State Board of Health has demonstrated that it has little or no effect in decreasing the organic ingredients, and Professor Leed's experiments upon the water both above and below Niagara Falls, where a natural aeration is carried on on a most stupendous scale, showed that there was no chemical purification.

But by far the most important consideration when river-water is to be used for drinking is the presence of pathogenic micro-organisms. We know that certain diseases may be transmitted by means of the contamination of water with their specific poison, and it is known that the poison consists of bacteria. Cholera and typhoid fever are diseases of this type. If the intestinal discharges from persons suffering from these diseases find their way into a river and thus reach a public water supply the most disastrous consequences may occur to the users of the water. The vital question is, do these bacteria disappear as the result of natural agencies at work in the river, and if so, how long an interval is required to accomplish this result. It is well known that most pathogenic bacteria do not propagate in ordinary river water, but on the other hand tend to die out. But they die slowly and may live for days and perhaps weeks. Investigation alone can show whether in running rivers there are factors which operate more unfavorably than in confined waters. Observations on the bacterial contents of a river are not readily made, some of the difficulties of chemical analysis holding for biological as well, and observers are not all agreed upon results.

Frankland found in the Thames and Ure that there was no apparent diminution in the number of organisms as the river flowed along. Elaborate tests were made on the River Spree at Berlin by Frank. Specimens were taken at fifteen different stations above, below and in the city and subjected to bacteriological examination. It was shown that although sometimes hundreds of thousands of bacteria were added to each centimetre of water flowing through the city the number was in the course of a few miles reduced to 3000 to 8000, about the same as above the city. It is probable that this result was due largely to sedimentation.

In the Isar, thirty-three kilometres below Munich, the point of pollution, the bacteria were reduced from 15,231 to 2378.

The following is the average result of ten tests on the Limmat, which flows out from Lake Zurich, past the city of the same name.

STATIONS.	DISTANCE.	NUMBER OF BACTERIA PER C. C.
Outflow from lake,	0	225
Station 1,	1.86	1,731
Sewer outlet,	2.175	296,670
Station 4,	2.485	12,870
" 5,	2.796	10,892
" 6,	3.417	5,902
" 7,	5.903	4,218
" 8,	6.214	2,346
" 9,	8.078	2,110

It has been inferred by some from these experiments that rivers can be relied upon to purify themselves or free themselves from disease-producing organisms by the natural flow of a few miles. I do not, however, think that this is a safe assumption. The difficulty in conducting such experiments is so great, and the knowledge that we possess of the conditions of life for pathogenic bacteria in running water is so scanty, that we are not justified in considering that water can be thus purified. Moreover there are many observations which show that rivers are not so purified.

Thus at Providence an epidemic of typhoid fever was traced to a very slight pollution of a large and rather rapid stream three and a quarter miles above the intake of the city supply.

The city of Philadelphia suffers continually from a high typhoid death rate, and this is due unquestionably to the pollution of the Schuylkill River by sewage, much of which contamination takes place many miles above the intake.

The Merrimac River is polluted by sewage at many points along its course, especially at the cities of Concord, Nashua, Lowell and Lawrence. Typhoid fever has for many years been exceedingly prevalent at Lowell and Lawrence, which take their water supply from the river, although Lowell is fourteen miles below Nashua and Lawrence nine miles further down than Lowell. Moreover, when Lowell has suffered from an exceptionally severe outbreak, Lawrence has had the same experience soon afterwards. Newburyport is seventeen miles below Lawrence and takes its water from springs, but two years ago, this supply being low, a pipe was extended into the Merrimac, and soon after an epidemic of typhoid occurred. These failures in self-purification are very instructive from the fact that the river flows so many miles without being freed from disease germs, and secondly because the river is very large as compared to the amount of sewage which enters it.

From theoretical and experimental considerations, and still more from the experiences first related, we must believe that a river once infected with disease-producing bacteria undergoes only a moderate degree of self-purification. What there is, is because the bacteria either settle to the bottom or die. Complete subsidence probably cannot take place in a flowing river, and as from one to two weeks are required to destroy the vitality of certain kinds of pathogenic organisms it can be only very rarely that conditions necessary for entire purification are found. As sewage is always likely to contain disease-producing organisms it follows that a river which receives sewage should be considered unfit to serve as a public water supply. Certainly if in rare cases it may be safe so to use it, we are not yet able to predicate the necessary conditions.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as a proof of good faith.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The Editor will be glad to publish any queries consonant with the character of the journal.

Palæolithic Pottery.

As bearing upon the discussion about the so-called *hiatus* between palæolithic and neolithic times, Dr. Brinton has made a statement in his "Notes on Anthropology" (*Science*, March 9, 1894), to which I must decidedly demur. He says, "All must now concede that palæolithic man made pottery, which was long denied him." I suppose that Dr. Brinton relies for this statement mainly upon the authority of the Marquis de Nadaillac, in various works, and especially in his "Manners and [illegible] historic Peoples," p. 100. But that gentleman is a closet archæologist and not an explorer, and he bases his opinion upon antecedent probability, and not upon personal knowledge, citing certain authorities of at least questionable value. In the single instance in which he makes an assertion upon his own authority he is certainly wrong. After stating that "Evans and Geikie in their turn assert the absence in England of palæolithic pottery, and Sir J. Lubbock energetically maintains this opinion," he adds in a note "But what is the value of categorical assertions of this kind in presence of the fragments of pottery found at different levels in Kent's Hole?" Now, as I have had occasion to say elsewhere, if this statement were correct, it might be regarded as settling the question, for never were investigations conducted more carefully and more scientifically than were those carried on for fourteen years by Mr. Pengelly, at Kent's Hole, near Torquay, on behalf of the British Association. This is what he says in his report made to that body in 1873, p. 213: "The men of the black mould had a great variety of bone instruments; they used spindle-whorls, and made pottery, and smelted and compounded metals. The older men of the cave earth made few bone tools; they used needles and probably stitched skins together; but they had neither spindle-whorls, nor pottery, nor metals." There could not be a plainer assertion than this of the absence of pottery from the more ancient deposits in Kent's Hole.

So, too, Prof. Boyd Dawkins, whose researches in the bone-caves of England are known to men of science the world over, says in "Early Man in Britain," p. 209: "There is no reason to suppose that the cave men used vessels of pottery, since no potsherds have been discovered in any of the refuse-heaps which have been carefully explored in France, Germany, Switzerland and Britain. The round-bottomed vase from the Trou du Frontal, considered by M. Dupont to imply that the art of pottery was known at this time, is of the same fashion as those of the neolithic age from the pile dwellings of Switzerland, and probably belongs to that age. . . . Had the cave men been acquainted with the potter's art, there is every reason to believe that traces of it would be abundant in every refuse-heap, as they were subsequently in those of all pottery-using peoples, a fragment of pottery or of burnt clay being as little liable to destruction as a fragment of bone or of antler."

It is upon these discoveries of M. Dupont that De Nadaillac rests his belief that in Belgium, at any rate, the cave men made a rude pottery, while the mammoth and the cave bear were still their neighbors. But it is a fact that among the fragments of pottery discovered by Dupont in the Belgian caverns were some that had been made upon the potter's wheel; and it is certainly remarkable that "the round-bottomed vase from the Trou du Frontal" was quietly withdrawn from the glass cases of the Brussels Museum ("Matériaux," x., 332; xvi., 124).

Within the past ten years some discoveries made by M. Fraipont, and his co-laborers, in certain Belgian caverns at Spy, Engis and Petit-Modone, have been supposed by some persons to lend confirmation to Dupont's views. But the thorough discussion of these finds by M. Cartailhac in "Matériaux," xxii., 63–78, shows upon how slight a foundation they are based. The most they can be held to establish, if they are proved, is that during the age of the mammoth, pottery was invented by one tribe of savage hunters, living in Belgium; that the knowledge of it never spread, and was finally lost, without having been transmitted to the men of the age of the reindeer.

M. Salomon Reinach, in his masterly "Description

[Saint Germain-en-Laye," p. 157, te of opinion in France on this ighly impartial fashion: "The of the cave men) is doubtful; at ilege of some few tribes. The covered in the quaternary beds been introduced there through of burrowing animals;" and in a note, giving a bibliography of authorities, upon this difficult question of quaternary pottery one can always fall back upon later disturbunce of the beds, as do MM. de Mortillet and Cartailhac, who deny formally the existence of pottery in the age of the reindeer."

I think these citations are ample to show that all do not concede that palæo'ithic man made pottery.

HENRY W. HAYNES.

Boston.

Mr. MacDougal and Poisoning from Cypripedium spectabile.

In Bulletin No. 9, Minnesota Botanical Studies, are several interesting papers; and Mr. D. T. MacDougal's paper "On the Poisonous Influence of Cypripedium spectabile and Cypripedium pubescens" is of special interest because there is conclusive evidence that at least one of these plants is poisonous to some people. Both of these species are common in parts of Minnesota and Wisconsin, and I remember at least one case of supposed poisoning from the Large White Lady's Slipper. Some twenty years ago this species was common in rich moist woods in the coulés and ravines near springs and in the marshes of western Wisconsin. Children used to collect this species in large quantities, and on one occasion a young man collected a large quantity of the flowers, followed by a swollen face. It is so long ago, however, and as I could scarcely have been more than ten or eleven years old, I do not remember more than the collecting of the flowers and that his swollen face was attributed to this plant. It may have been from Poison Ivy, which is common in this region, but the person insisted he was poisoned by this Lady's Slipper. Mr. MacDougal gives the following interesting experiment, which leaves no doubt as to the poisonous character of the plant to some persons at least: "The author, while in the field at Twin Lakes, near Minneapolis, September 7, 1893, met with several well grown plants of *C. spectabile*, with newly formed seed pods. A robust specimen was broken off near the base of the stem, and the leaves were brushed lightly across the biceps muscle of the bared left arm. A slight tingling sensation was felt at the time, and fourteen hours later the arm was greatly swollen from the shoulder to the finger tips." He finds two kinds of hairs, one glandular, the other pointed. The poisonous effects may be due to the piercing of the skin by the pointed hair and the consequent action of the acid contents, or the surface irritation by the contents of the glandular hairs. Seventeen other plants found in Minnesota are enumerated which are poisonous to the touch, and some of these are common weeds like Cocklebur (*Xanthium canadense*), Horse Weed or Fleabane (*Erigeron canadense*) and White Spurge (*Euphorbia corollata*). The writer of this note is extremely sensitive to the action of Poisonous Ivy (*Rhus vernix*), but *Primula obconica*, which is said to be poisonous to some people, had no effect nor did it have any effect on several students working in the botanical laboratory on whom the experiment was tried. I know of one person who is systematically poisoned when he picks up wild grass. When questioned he stated that Poison Ivy was not seen by him. This matter of poisoning to the touch by different plants is largely a matter of individuality and condition of the system. Previous to 1886 I could pick and cut Poison Ivy with impunity, but in the spring of that year I was poisoned, and ever since I have been sensitive to its action. I may state that at the time I was subject to a slight bilious attack. I was perspiring very freely. I am certain that I touched my eyelids and face; had I not done so I would have been free from its effects.

L. H. PAMMEL.

Iowa Agricultural College, Ames, Iowa.

A Miniature Water Lily.

I HAVE been shown Mr. H. B. Ayres's note in the last number of *Science*, in which he credits me with having found *Nymphæa odorata var. minor* on the Moose River, near James Bay, in 1885. Though I ascended the Moose River in that year, I neither collected nor saw this plant. In the year 1886, however, in lat. 54, near the head waters of the Severn River, which runs into Hudson Bay, I did collect a *Nymphæa* which I took to be *N. odorata var. minor*. Specimens were sent to Dr. Britton, who identified them as *Castalia pygmæa*, Salisb. (*Nymphæa pygmæa* Ait. = *N. tetragona*, Georgi). Dr. Britton wrote me at that time: "The plant may be at once distinguished from the eastern *N. odorata var. minor*, by the oblong leaves, sometimes nearly twice as long as broad, with narrow, acutish lobes and the flowers still smaller, with seven to eight rayed stigma." The specimens in the herbarium of this department were then examined, and it was found that specimens collected by Dr. Robt. Bell, in 1879, on the Mesinabic River—a branch of the Moose River—and named *N. odorata var. minor*, were also this species.

Mr. Wm. McInnis, of the Geological Survey Department of Canada, reports a small *Nymphæa* as being abundant in some of the small lakes east of the Rainey Lake, almost due north of Red Lake. It seems to me probable that both these and the Red Lake and Turtle Lake plants are *Castalia pygmæa* and not *Nymphæa* (*Castalia*) *odorata var. minor*.

JAS. M. MACOUN.

Geological Survey Department, Ottawa.

The Swastika Cross.

THE display of relics in the anthropological building of the Columbian Exposition, collected by Mr. Warren K. Moorehead from a cluster of mounds near Chillicothe, Ohio, contained, among many other very interesting objects, a large number of Swastika crosses made from thin strips of copper. The occurrence of copper ornaments of that shape so perfectly wrought, and in such numbers, occasioned much surprise, and attracted great attention. A communication which I made to the *New York Independent* of Nov. 16, describing these objects, has brought to me two interesting communications from widely separated portions of the globe giving valuable information concerning the wide-spread use of this symbol.

Mr. John Thorgeirson, writing from Bannacks, Montana, tells me that an ancient MS., owned by his grandfather, in which there were many runic characters, represented Thor's hammer as of the form of the Swastika cross. It is interesting to note, also, that before Christianity had wholly subdued the Northmen the sign of the cross and of Thor's hammer, when made before partaking of festive draughts, were sometimes confounded, greatly to the misunderstanding of spectators.

Another communication from Rev. F. H. Chalfant, missionary at Shantung, China, informs me that the same symbol is among the mystic Chinese characters, to wit, "wan" (卍), and is a favorite ornament with the Chinese.

This occurrence of so peculiar a symbol in countries so widely separated as Scandinavia, China, and the Mississippi Valley is certainly suggestive either of an original con-

nection between the races which migrated to those regions, or of early intercommunication between them. But my own information upon the subject is too scanty for me to discuss it further. G. FREDERICK WRIGHT.

Oberlin, O.

Nature Study in the Schools.

IN *Science* of March 2 an article on "Botany in the Schools" calls attention to a subject of interest to all teachers. "Nature Study," it may be assumed, has come to stay. It is too important a factor in education to be left out, even though its first introduction into the schools be accompanied with mistakes and inefficiency. This being granted, it is very reasonable to say, as does the writer of the article mentioned, that for the best results "a competent specialist should be put in charge of the work who could instruct the teachers, just as the specialist does in music and drawing." Nothing less than this, certainly, should be demanded of normal schools and large city schools having their own training departments. Teachers adapted to the work and thoroughly equipped for it should be put in charge of the training for science-teaching in the grades for the relief of the academic science teachers, whose regular work follows advanced methods, and for the more efficient application of the principles which govern elementary teaching. The State Normal School of Michigan sends out nearly two hundred graduates a year, many of them from the longer courses of study. The training schools of the large cities send out many more, and there is thus sent into the schools of the State each year a large body of teachers who know the meaning and the methods of "Nature Study."

But in any state, the large city schools form only a small portion of the aggregate. There are many schools in which the question of economy must regulate matters, and many schools which are not large enough to require the services of a special teacher. Shall these schools, then, "drop the subject altogether from the curriculum?" We answer decidedly not. Intelligent teachers, by reading and by study and use of material, should be able to fit themselves to do good work in this as well as in other lines. There are plenty of recent publications for their benefit, some of more, others of less, value. There are occasionally helpful lectures, and sometimes regular instruction at teachers' institutes. Every year the helps grow more numerous and are within easier reach. Current educational literature on this subject is not yet so abundant as it ought to be, but the demand will bring the supply. The educational journals have much that can be utilized, and there is one publication which is devoted to his work exclusively. This is *The Field and School Naturalist*, published at Minneapolis, which has absorbed *The Naturalist Teacher*, the modest little monthly started few years ago by Professor McLouth, special science teacher in the schools of Muskegon, Mich. There may be other publications of similar character; certainly there soon will be others in the field, for the demand is imperative. With such helps the question of "Nature Study" should not be a question of alternatives, but rather one of doing in each school the very best the conditions will allow. LUCY A. OSBAND.

Michigan State Normal School.

A Brilliant Aurora.

AN aurora of unusual brilliancy and splendor was observed at Madison, Wis., on the evening of Feb. 23. A somewhat less notable display was seen on the night of the 22nd, but, so far as noted, it consisted only of the usual luminous arch, surmounted by long and rather brilliant streamers, which were white of the arch and rosy red at the extremities.

The display on the evening of the before nine o'clock, consisted of resting on a dense dark one, while visible about three degrees below lower arch was not, at first, surmounted by a luminous portion. But few streamers were visible at this time. Stars were plainly seen in the space between the two arches, but not through the upper arch. In a few minutes the lower arch became somewhat luminous, and the dark portion of the upper arch became lighter.

At nine o'clock, at the eastern limb of the upper arch, a series of brilliantly colored streamers began to shoot up with great rapidity. The streamers were broad rather than long, and they had a swift westward motion. Nearly all were of several colors—red, yellow, green and white—in well marked, not very wide, bands. These streamers quickly assumed the appearance of swaying flags or curtains, and rapidly traversed the arch, moving toward the west. They seemed to occupy the space between the arch and the observer, and to absorb the arch as they advanced. Just before the front of the luminous folds reached the highest point of the arch, the latter was seen bending swiftly down in a double curve to about the position of the lower arch spoken of, but which was not then visible, and merging in the pendulous folds of the advancing, swaying curtains.

When the western limb was reached, brilliant streamers of white and crimson shot up to the zenith from both extremities of the arch with the swiftness of fierce flames but with only a slight swaying motion. The curtain-like folds had disappeared. The time occupied in the passage of the phenomena described was less than fifteen minutes. How much longer the display lasted and what was its character was not noted.

The magnetic disturbance was very considerable. After the brilliant portion of the display was over a compass was carefully adjusted and the deflection of the needle noted. The amount of the deflection at the end of fifteen minutes was 3°, 58′ to the west.

Although the movement of the needle was rapid,—most of the deflection occurred during the first five minutes,—the motion could not be perceived by the eye.

G. E. CULVER.

Madison, Wis.

The Durability of the Poisonous Property of Poison Ivy, Rhus Radicans L. (R. Toxicodendron L.).

A RECENT experience indicates that the poisonous principle of the above named plant is lasting.

In the botanical museum of Ohio State University are some stems of Poison Ivy that were deposited there not less than three years ago.

About ten days ago I noticed that they were infested with borers—the larva of some beetle. Desiring to study the beetle, the stems were broken a few times so that they would go into a covered glass jar. They are found to be bored through many times, so that they broke easily, and at every breaking the powder from the borings flew freely. I had no fears of being poisoned, but about 3.00 A.M. the next morning I was awakened by an itching between my fingers as if poisoned. Later development proved that it was poison, and I can account for it in no other way than that it came from the Poison Ivy. The burning was abated somewhat by the application of olive or sweet oil but lasted for several days. The epidermis is now coming off the affected part exactly as when having been poisoned with Rhus venenata D. C. E. E. BOGUE.

Columbus, O., Feb. 12, 1894.

genus was described in 1852 by Dr. John various fragmentary remains obtained additional species have since been debased upon the still more uncertain the teeth alone. The genus has thus had a very doubtful existence, or has been merged into *Dicotyles*. The recent acquisition by the University of Kansas of several skeletons of a species, which, from the comparison of Leconte's figures, I believe belongs here, enables me to give for the first time satisfactory generic characters. This species, which may be known as *P. leptorhinus* Will., is of about the same size as the type, *P. compressus* Lec., from which it is at once distinguishable by the angle of the jaws, which is shaped as in *Dicotyles*, though not at all inflected. From *P. striatus* Marsh, from the Pliocene of Nebraska, the absence of striation of the second premolar tooth (upon which the species was based) will separate it. A figure of the restored skeleton, with a full description, will shortly be given. For the present, the following characters will be of interest: The dentition is like that of *Dicotyles*, except that the incisors are much smaller, and the third lower one is wholly wanting. The molars show a partial confluence of the cusps, but the difference from *Dicotyles* in this respect is not striking. The most remarkable character which the genus shows is the entire absence of the outer toes on both hind and fore feet. They are represented by short splints, which do not reach to the middle of the conjoined metapodials. There are other characteristic differences in the carpus and tarsus, which will be best shown by the aid of figures. The animals were decidedly stouter in form than the living peccaries and stood about thirty inches in height. The last premolar of the milk series had three series of cusps.

S. W. Williston.

Lawrence, Kansas.

BOOK-REVIEWS.

Neudrucke von Schriften und Karten über Meteorologie und Erdmagnetismus. Herausgegeben von Prof. Dr. G. Hellmann.

No. 1. *L. Reynman, Wetterbuechlein. Von wahrer Erkenntniss des Wetters*, 1510. Facsimiledruck mit einer Einleitung. Berlin, A. Ascher & Co., 1893, 4to, 42,14 p. 6 marks ($1.50).

No. 2. *Blaise Pascal. Récit de la Grande Expérience de l'Equilibre des Liqueurs. Paris*, 1648. Facsimiledruck mit einer Einleitung. Berlin, A. Ascher & Co., 1893, 4to, 10,20 p. 3 marks (75c.)

In view of the growing interest that is being shown those infant twin sisters of astronomy—meteorology and terrestrial magnetism—it may not be amiss to call the attention of the readers of *Science* to the above-named series of excellent reprints in facsimile of rare old books and charts that have been epoch-making in the subjects named. Additional importance is to be attached to these reprints in that they are edited by a scholar whose keen critical ability and power for careful, painstaking research have put him in the front rank of the meteorologists and bibliographers of the day.

With the coöperation of the German Meteorological Society and its Berlin branch, the above two numbers have been issued and others promised, such as Luke Howard's "On the Modifications of Clouds, 1803," in which we have the first attempted classification of cloud formations; "Halley's Isogonic Chart of 1700"—the first of the kind; "Humboldt's Isotherms, 1817"—the earliest drawn; and others. As the chief object in view is to make these classic works, the originals of which are well-nigh unobtainable and very expensive, accessible to every one interested, they are published at the low price named above. Professor Hellman and his coöperators have thus earned for themselves the highest praise and deserve the heartiest coöperation.

No. 1, a most elegant volume, is a facsimile reprint (preceded by a careful and critical discussion by Professor Hellmann) of the oldest meteorological book printed in German. It may, thus, apparently, have more of a *local* interest. The fact, however, that it ran through seventeen editions in thirty-four years, the earliest being in 1505, of which no trace can now be found, and that it was almost literally translated in "The Boke of Knowledge of Thynges Vnknown, apperteyning to Astronomy, with certain necessarye Rules," published in London in 1585, already enhances the interest in the book. It was besides incorporated in many other works. It was the first attempt at emancipation from the astrological superstitions of the day. In their stead the author strove to substitute simple rules (many in rhyme) based upon natural laws and phenomena. The book thus possesses an interest not only to the professional meteorologist, but also to the bibliographer, the historian, the student of folk-lore, in fact, to all who are interested in the gradual growth of the human mind and in the throwing off of the shackles imposed by the Middle Ages. Of the seventeen editions, Professor Hellmann, through correspondence with one hundred and fifteen libraries, could barely trace more than three dozen copies. The reprint has been made from the second edition of 1510, the only copy of which being in the possession of Professor Hellmann. Of Reynman little could be learned except that he lived in classic Nuremberg, about 1520, and was thus a contemporary of such illustrious men as Georg Hartmann, Albrecht Dürer, and a host of eminent scientists. In writing his book he drew largely upon a large astrological treatise by Guido Bonatti, an Italian astrologer of the thirteenth century, which was published in 1491, and upon "Oposculum repertorii prognosticum in mutationes æris, 1485," by Firmin de Belleval, a Frenchman, otherwise unknown.

No. 2. This volume will surely interest every scientist. It is the reprint of a work of the greatest rarity, as but three copies, two in Paris and one in Breslau, could be found, the one in Breslau being used in the reproduction. In this volume is given the first experimental proof that the pressure of atmospheric air is the cause of the rising of mercury (or any other liquid) in an inverted tube previously exhausted of air and placed in a trough of mercury—the memorable experiment of Torricelli (or rather one of his pupils), in 1643. Up to the time of the publication of this interesting tract, the universal belief was that the cause was to be sought in nature's *horror vacui*. The experiment was most carefully and scrupulously carried out by Perier, a brother-in-law of Pascal. The first eight pages of the facsimile reprint form the letter of instructions sent to Perier by Pascal, Nov. 15, 1647. On Sept. 22, 1648, Pascal received the happy news from Perier of the successful outcome of the experiments. (See p. 17–20). Perier filled two tubes with mercury and saw that their readings agreed at Clermont. He then emptied one and carried it to the top of the Puy de Dome (3550 feet above Clermont) and after filling it again with mercury, found the reading less. After repeating the experiment at a station half-way down, he descended to Clermont and again filled his tube, but now found that it read the same as the one previously left there. Hence, ascent in the air or decrease in height of superincumbent atmosphere meant a fall in the barometric reading, or decrease in pressure. The conclusion was at once evident

ise was to be ascribed to the atmosphere. upon receiving the great news, Pascal hastily ict and gave to the world the knowledge of ret. It is the reproduction of this herald of covery that Professor Hellmann has given us. again re-published, but was incorporated ered in the "Traitez de l'Equilibre des c., published in 1663 by Perier, one year after ch. Hence it is usually believed that the ave us the first account.

known, it is believed by many writers that d suggested these experiments to Pascal, and, nade that claim in two letters of 1649 to scal, as he expressly states in his "Récit," "horror vacui" up to the time of the suction of Perier's experiments, nor did he ever tes's statements. After weighing all the efully, Professor Hellmann believes he has Mr. Mourisson, who in his recent work[1] nst Pascal. Whatever may be the truth, the hat Pascal first gave this important discovery that no little credit must be given Perier for is care (He even surrounded himself with that "none could deny") with which he e experiments, and that Professor Hellmann earned the praise of the whole scientific ding at the command of every one such a ecuted copy.

d'Argent. Par H. GAUTIER. Paris, Gauars et Fils. 203 p., 1893.

ge des Objectifs Photographiques. Par E. Paris, Gauthier-Villars et Fils, Quai des ugustins, 196 p., 1893, Broché, 2 fr. 50, , 3 fr.

these works relates to the preparation and e precious metals, and to their monetary and In the preliminary part the author gives a of the chemical and physical properties of netals and of those metals with which these alloyed. The principal alloys used in coinrelry are described, together with the legal ised upon them. It is very instructive to ely this official circumspection is carried on l we are forced to regard the looseness curca with much dissatisfaction. The second ok is devoted to the purely practical side of describing methods of refining and of as. as of analysis by the wet method.

as aimed to make his "Choice and Use of Objectives" essentially a practical discusall act as a guide to the professional and grapher alike, assisting them both in the r lenses and giving an insight into the requiessful picture. The book is rather more ndicates, for, without being abstrusely scienone to an excellent theoretical as well as ledge of the photographic apparatus.

Points in the Science of the Earth. By Sir AM DAWSON, C.M.G., LL.D., F.R.S., etc. New York, Harper and Brothers. d, 469 p., 1894, $2.

Jameson, a friend and co-worker with Murrick, Phillips, Logan, Gray, Lyell, and, l those historians of the earth's past who nuch to elevate mankind and to bring him f his Creator's greatness, Sir J. William s no introduction to an English-speaking ways exhibiting a true Christianity and remost specialized researches a wonderful

[1] "Pascal Philosophe, etc." Paris, 1888.

conception of the great tr endeared himself to many those who have devoted geology. "The Earth ar World," "Science in Bibl library, and his many purely valued aids in all geologic "The present work (we qu that is new and much in correction and amplification of that which is old; and is intended as a closing deliverance on some of the more important questions of geology, on the part of a veteran worker, conversant in his younger days with those giants of the last generation, who, in the heroic age of geological science, piled up the mountains on which it is now the privilege of their successors to stand." In the rush of modern thought, in the *fin de siècle* annihilation of all that has been laboriously erected by our teachers, we are too often liable to forget that these edifices have a foundation which it will profit us to study. In the narrowness of our progress we see only an architecture incompatible, we believe, with the conditions of our greater knowledge, and hence we reject the same to build for ourselves higher structures, may be, but too often with a sacrifice of solidity, to brilliancy and originality of design. It is, then, exceedingly wholesome to take up such a work as the present and to be reminded that there are some, with an experience that few of us can hope to attain, who still cling to the fundamental theories with all the vigor of youth, and who remain undisturbed by the gyrations of modern scientific philosophers. In this "closing deliverance" by Sir William we find a series of chapters each gracefully dedicated to one of those whose labor and life have been given in corresponding research. The subjects discussed are indicated in the title, being those great problems which have presented themselves from the dawn of our extended understanding of the world's history; the process of world making, the first life, the nature of the geological record, the genesis and succession of the earth's fauna and flora, the cause of climatal change, the great ice age and pre-historic man—these are a few of the "Salient Points" which will interest all, whether scientists or laymen in the perusal of this charming work.

Conférences Publiques sur la Photographie. Organisées par LE DIRECTEUR DU CONSERVATOIRE NATIONALE DES ARTS ET METIERS. Paris, Gauthier-Villars et Fils. 545 p., avec 198 figures et 9 planches, 1893. 7 fr. 50c.

THE above unique work embraces nineteen lectures on Photography organized by the eminent Colonel Laussedat, Directeur du Conservatoire des Arts et Metiers, and delivered at that institution during the years 1891–92. Each lecture or conférence constitutes a monograph in its particular subject and in every case has been written by a specialist and originator in that subject. The lectures are here reprinted in the order of their delivery, and though a text-book graded arrangement is not possible the work as a whole is a complete and most valuable treatise on both theoretical and technical photography. Photography is essentially a French science, an art of French invention and in France is carried to its greatest perfection. In fact, nowhere else has it been made, or rather acknowledged to be, so truly a science or so worthy of scientific study and experiment. The contrast is particularly marked when comparing photographic literature of our own country, for instance, with the literature of the same subject in France. Of the many admirable works there recently published none will be likely to find more pleased readers than will this present volume of conférences. It is impossible even to attempt a synopsis of the many subjects treated, but the titles of a part at

to the scope of the work. The ...vaune is a charming historical ... and application of Photography ...e to the present day.

...e study of moving bodies, is ...ny; Photography in Colors, by ...e Faculty of Science of Paris; ...graphy, by Prof. J. Janssen, Director of the Astronomical Observatory of Meudon, and Photographic Chemistry by M. C. Fabre. To enumerate rapidly the titles of other lectures we have: Medical Photography, Military Photography and Photocartography, Photogravure and Photochromography, the Photographic Objective, Photographic Processes, the Photography of Natural Phenomena, Iconometry and Metrophotography (sciences but little understood in this country but of the greatest importance), Microphotography, the Production of Panoramas, etc., etc.

The book is printed on heavy paper, and the typographic work is in excellent style. The illustrations in most cases are reproductions of photographs and while illustrating the text are in ...emselves works of art, adding a further charm to the ...olume.

NOTES AND NEWS.

THE impetus recently given to nature-study in the secondary schools has led to a demand for the more thorough preparation of teachers in the essentials of botany and zoölogy. Teachers cannot get special training in these branches during the college year, because it coincides with their teaching year. In the past their opportunities for getting it during summer have been limited, on account of the lack of summer schools. To meet this demand the New Hampshire College, coöperating with Superintendent Gowing, of the State Department of Public Instruction, will institute next July a summer school of biology, especially adapted to the needs of teachers in the secondary schools. The instruction in botany will be given by Principal Charles H. Clark, A.M., of Sanborn Seminary, Kingston, N. H.; and in zoölogy by Prof. Clarence M. Weed, D.Sc., of the college. Supplementary lectures will also be delivered by President Chas. S. Murkland, Ph.D., and Superintendent Fred Gowing, of Concord. The school will open Thursday, July 5, and continue until Saturday, Aug. 4. It will be held in the laboratories and class rooms of Thompson Hall, students being granted free use of the library, microscopes, aquaria, collections, and other facilities. The laboratory instruction will be supplemented by work in the field and class-room, and by informal discussions of such topics as are likely to prove useful for illustrative purposes in nature-study in the lower schools. The course of study will cover the line of work in botany and zoölogy recommended in the recent report of the Committee on Secondary School Studies, appointed by the National Educational Association for adoption by the secondary schools. In addition, there will be offered, to such teachers as may desire it, an opportunity of taking a special course in microscopical technique under Principal Clark, or in elementary entomology under Professor Weed. The situation of the college is peculiarly favorable to the study of natural history. Plants and animals inhabiting a great variety of land surface, as well as fresh, brackish, and salt water, are easily accessible.

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article on "The Synthetical ... in *Science*, Jan. 19, 1894.

... studies in the southern part of the republic of Costa Rica, which are now conducted by Enrique Pittier, director of the Physico-geographic Institute at San José, in behalf of the government, have been fruitful in results. His explorations in the Terraba and Boruca portions of the Pacific slope were continued during several seasons and disclosed the fact that the Terraba Indians are not individuals of a homogeneous ... tribes gathered ... now inhabit, ... by Francis-... Among this assemblage of tribes the ... who formerly had their home on the ... coast, were prominent, and ... the whole ... tribal remains were comprehensively called ... or Terrabas. The district of ... Terrabas was ... ins. In fact it ... of the Bribris ... tic side of the ... cognate to the ... ow living three ... leaves both of the above. On their trading journeys they sometimes visit San José, the capital, and from their homes they reach it in eleven days. They are not communicative concerning their own vernacular, and the writer experienced considerable difficulty in getting collections of words, terms, and phrases. Long acquaintance, however, from the Terrabas and are of great ... as may be readily guessed from what we ... about the formation of the Terraba ...

—The executive committee of the Association of Official Agricultural Chemists has decided to call the annual meeting of the Association for August 23, 24 and 25, 1894. The meetings will be held in the lecture room of the National Museum at Washington, beginning at ten o'clock on Thursday, August 23. The reporters for the meeting are as follows: Phosphoric acid, B. W. Kilgore, Raleigh, N. C.; Nitrogen, J. M. Bartlett, Orono, Me.; Potash, H. J. Wheeler, Kingston, R. I.; Soils and ash, A. M. Peter, Lexington, Ky.; Dairy products, E. H. Farrington, Champaign, Ill.; Foods and feeding stuffs, H. J. Patterson, College Park, Md.; ... reported by ... Geo. F. Colby, Berkeley, Cal.; Sugar, G. ... Spencer, Washington, D. C. The co-operation of European chemists has been invited in the analytical work, and several acceptances of the invitation have been received. It is urged upon all members who have communications to make to the Association to bring them properly prepared and ready for printing. Much delay has arisen heretofore in securing the manuscript promptly from the reporters and others presenting papers. The speedy publication of the proceedings will be greatly facilitated by bringing everything properly prepared.

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